SECTION NUMBER | TITLE

SECTION 01 10 00 - 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 by Owner.
4. Access to site.
5. Work restrictions.
6. Specification and drawing conventions.
7. Payment Procedures.
8. Miscellaneous provisions.

B. Related Requirements:

1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of site.

1.3 PROJECT INFORMATION

A. Project Identification:

1. Project Location: 17 Hyatt Street, Providence, Rhode Island 02903

2. Owner: City of Providence, Department of Public Property

3. Owner's Representative: Downes Construction, Rhode Island

B. Architect: Rowse Architects, Inc., 400 Massasoit Avenue, Suite 300, East Providence, Rhode Island 02914

C. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
1. Structural Engineering: Pare Corporation, 8 Blackstone Valley Place, Lincoln, Rhode Island 02865
2. Building Technology Consulting: William E. Hooley, 992 Bedford Street, Bridgewater, Massachusetts 02324
3. M.E.P. and Fire Protection Engineering: Building Engineering Resources, Inc., 351 Centerville Road, Warwick, Rhode Island 02886

1.4 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": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

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

1.5 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The project consists of renovations to the Joslin Recreation Center including but not limited to interior demolition and installation of new walls and spaces. Full renovations to restrooms and showers. New audiovisual and security upgrades. Replacement of HVAC systems to provide an all-electric energy-efficient cooling and heating system throughout the Recreation Center, including electrical system upgrades to support new micro-grid systems. Roof replacement and modifications.

2. The building is designed in accordance with the 11th Edition of the Rhode Island State Building Code (2012 Edition of IBC with RI Amendments) and the Rhode Island Life Safety Code (2012 Edition of NFPA 101 with RI Amendments).

B. The contractor must provide all material, labor, tools, plant, supplies, equipment, transportation, superintendence, temporary construction of every nature and all other services and facilities necessary to complete the construction for the Owner, including all incidental work as required or described in the contract documents.

C. Type of Contract:

1. Project will be constructed under a single prime contract.

1.6 WORK BY OWNER

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.7 ACCESS TO SITE

A. General: Contractor shall coordinate with Owner and included Logistics plan(s) for use of Project site for construction operations during construction period. Contractor's use of Project site is limited by Owner's right to perform work or to retain other contractors on portions of Project.

1.8 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to working hours of 8:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated.

1. Weekend and Overtime Hours: Shall be as approved by the Owner and Architect. This is not to limit the hours the contractor can perform work, but to only allow the Owner and Architect to have personnel available (in person or by phone) for questions or other issues.
2. Early Morning or Evening Hours: Shall be as regulated by authorities having jurisdiction for restrictions on noisy work.

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 providing temporary utility services according to requirements indicated:

1. Notify Owner not less than four days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner or others.

1. Notify Owner not less than four days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.

F. Controlled Substances: Use of tobacco or controlled substances on Project site is not permitted.

1.9 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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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

C. 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 published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.10 CODES, RULES AND REGULATIONS

A. All work is to be in accordance with the latest requirements of:

1. Federal, State and Municipal Laws
2. Rhode Island Building and Fire Codes
3. National Plumbing Code
4. National Electric Code
5. Any prevailing rules, regulations pertaining to adequate protection and/or guarding of any moving parts or otherwise hazardous locations.

1.11 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. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.12 JOB SAFETY AND ACCIDENT PREVENTION

A. All construction work on this project must be performed in compliance with the Occupational Safety and Health Act of 1970 or with local or State occupational safety and health regulations enforced by an agency of the locality or State under a plan approved by the U.S. Department of Labor Occupational Safety and Health Administration (OSHA)

B. All contractors and subcontractors shall comply with requirements of the Occupational Safety and Health Act of 1970 or revisions thereto, which are applicable during the term of this contract and hold the Owner and Architect and/or their agents harmless from any claim or loss that may result from violations of or claims under this act.

C. See the General Conditions for further requirements.

1.13 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

a. Application for Payment forms with continuation sheets.
b. Submittal schedule.
c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Architect at earliest possible date but no later than 15 days from date of notice to proceed.
3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments; provide subschedules showing values coordinated with each phase of 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. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

a. Include separate line items labor and materials.

3. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
4. 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.
5. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

8. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.14 APPLICATIONS FOR PAYMENT

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

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: Submit Application for Payment to Architect by the23rd of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 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 of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. 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. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

G. 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. Schedule of unit prices.

5. Submittal schedule (preliminary if not final).
6. List of Contractor's staff assignments.
7. List of Contractor's principal consultants.
8. Copies of building permits.
9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
10. Initial progress report.
11. Report of preconstruction conference.
12. Certificates of insurance and insurance policies.

H. 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 Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. 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 G706-1994, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A-1994, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707-1994, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.

1.15 MISCELLANEOUS PROVISIONS

A. SUPERINTENDENCE OF SUBCONTRACTORS

1. The contractor must supervise subcontractors in accordance with the provisions of General Conditions. A project superintendent shall be on site whenever any work is being performed. Superintendent shall be an employee of the Contractor.
2. Project superintendent shall be acceptable to the Owner and Architect. Submit superintendent’s qualifications for review and acceptance within two days of the notice of award or notice to proceed whichever is first.

B. COORDINATION

1. Prior to commencement of subcontract work, a designated representative of each subcontractor shall meet with project superintendent, Owner and Architect at the site to discuss requirements and scope of Work.
2. The Contractor and all subcontractors will be required to attend a preconstruction conference at a date and time set by the Owner.

C. BEHAVIOR OF PERSONNEL

1. If in the opinion of the Owner or Architect, any employee of the Contractor or his subcontractors is physically or mentally unfit for work or exhibits behavior incompatible with work site environment, said employee may be required to leave property and may be refused re-admittance.

D. SUBSTITUTIONS

1. In all cases where a proprietary designation is used in connection with materials or articles to be furnished under this contract and the phrase "or equal" is not used, the Contractor shall furnish the specified item, unless a written request for a substitute has been submitted by the Contractor and review by the Architect to his satisfaction.
2. See Section 01 60 00 for additional requirements and Contractor responsibility relating to substitutions. Specifically, subparagraphs relating to speculative substitutions and additional liabilities.

E. DRAWINGS AND SPECIFICATIONS

1. All work drawn on Plans and not specified or all work specified and not drawn are part of Contract Work required to be done and are to be executed as fully as if described in both of these ways. Only work specifically noted in the following manner shall be considered as not being in the contract:
2. ".....by Owner".
3. ".....NIC (Not In Contract)".
4. If, after examination of Contract Drawings and Specifications, or after a visit to the premises, any discrepancies, omissions, ambiguities, or conflicts are found in or amount contract documents or there is doubt as to their meaning, Architect is to be notified at the earliest possible date. Where information sought is not clearly indicated or specified, the Architect will issue addendum to the Contractor clarifying conditions, which addendum will become part of the Contract Documents. Neither the Owner nor the Architect will be responsible for any oral instructions.
5. If there are two ways and/or instruction in drawings and/or specifications, it shall be assumed that the Contractor has based his base bid price on the most expensive way.
6. If duplication is shown on drawings and/or specifications of work by more than one trade, Architect shall determine which trade shall do work and rebate shall be due from the other trades to Owner.
7. Drawings DO NOT include any necessary components for construction safety.
8. In all work shown on Drawings, figured dimensions are to be followed in all cases, though they may differ from scaled measurements. Before beginning the work, Contractor is to check through and verify all dimensions/elevations and call to the attention of the Architect any apparent or manifest discrepancy.
9. Contractor shall verify all dimensions with existing and actual field conditions, prior to start of any work.
10. All work and materials shown on drawings shall be interpreted by the Contractor as being new work and materials to be furnished and installed unless are specifically indicated as existing to remain.

END OF SECTION 01 10 00

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.

1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and 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.

B. Types of allowances include the following:

1. Lump-sum allowances.

C. Related Requirements:

1. Division 01 Section "Unit Prices" for procedures for using unit prices.
2. Divisions 02 through 33 Sections for items of Work covered by allowances.

1.3 SELECTION AND PURCHASE

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

1. If proposals are requested by the Architect the contractor shall provide a minimum of 3 proposals for each product or system.

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

1.4 ACTION SUBMITTALS

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

1.5 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. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

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

1.6 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.7 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 taxes, freight, and delivery to 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 selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

1.8 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

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 $1,500 for exterior building signage.

1. This allowance includes material cost, receiving, handling, and installation, and Contractor overhead and profit.

B. Allowance No. 2: Lump-Sum Allowance: Include the sum of $30,000 for unforeseen Electrical, Mechanical and Plumbing conditions uncovered during demolition.

1. This allowance includes material cost, receiving, handling, and installation, and Contractor overhead and profit.

C. Allowance No. 3: Lump-Sum Allowance: Include the sum of $15,000 for unforeseen Hazardous Material testing and abatement requirements uncovered during demolition.

1. This allowance includes Unit Cost pricing. Refer to specification section 012200.

END OF SECTION 01 21 00

SECTION 012200 - UNIT PRICES

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 unit prices.

1.3 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Except as indicate in preceding subparagraphs, Methods of measurement and payment for unit prices are specified in those Sections.

1. The abatement of the following items shall be quantified by in place survey methods

a. 12x12 Floor Tile & Black Mastic /sf

b. 9x9 Floor Tile & Black Mastic /sf

c. Pipe Insulation / 5lf

d. Elbows and Fittings - glove bag method / bag

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included on the “Form of General Bid” section 00 41 13. Specification sections referenced in the schedule contain requirements for materials described under each unit price.

END OF SECTION 012200

SECTION 01 30 00 – ADMINISTRATIVE PROVISIONS

PART 1 - GENERAL

1.00 GENERAL REFERENCE

A. The General Conditions, Supplementary General Conditions and Division 1 of these specifications are hereby included as part of this section.

1.01 REQUIREMENTS INCLUDED

A. Title of Work, and type of Contract.

B. Contractor Use of Premises.

C. Field Engineering.

E. Reference Standards.

F. Cutting and Patching

1. Requirements and limitations for cutting and patching of Work.

G. Supervision

H. Miscellaneous Administrative Items

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. Work of this Contract comprises of all labor, supervision, materials, equipment, and services required to complete the work as described on the drawings, as specified in the project manual, and as may be required by the existing conditions. The scope of work is described in section 01 10 00 Summary.

B. The contractor must provide all material, labor, tools, plants, supplies, equipment, transportation, superintendence, temporary construction of every nature and all other services and facilities necessary to complete the construction for the Owner, including all incidental work as required or described in the contract documents.

1.03 CONTRACT METHOD

A. Construction of the Work under single lump sum contract.

B. Items noted "NIC" (Not In Contract) and other items as indicated will be furnished and installed by Owner.

1.04 CONTRACTOR USE OF PREMISES

A. Limit use of premises for Work and for construction operations, to allow for work by Owner's employees.

B. Limit access to site and work areas as directed by the Owner.

1.05 JOB SAFETY AND ACCIDENT PREVENTION

A. All construction work on this project must be performed in compliance with the Occupational Safety and Health Act of 1970 or with local or State occupational safety and health regulations enforced by an agency of the locality or State under a plan approved by the U.S. Department of Labor Occupational Safety and Health Administration (OSHA).

1. All contractors and subcontractors shall comply with requirements of the Occupational Safety and Health Act of 1970 or revisions thereto, which are applicable during the term of this contract and hold the Owner and Architect and/or their agents harmless from any claim or loss that may result from violations of or claims under this act.

B. See the General Conditions for further requirements.

1.06 REFERENCE STANDARDS

A. For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. The date of the standard is that in effect as of date of Contract Documents when there are no bids, except when a specific date is specified. If governing codes reference standard date then code reference date shall be in effect.

C. Obtain copies of standards when required by Contract Documents. Maintain copy at jobsite during progress of the specific work.

1.07 CUTTING AND PATCHING

A. Submit written request in advance of cutting or alteration, which affects:

1. Structural integrity of any element of Project.

2. Integrity of weather-exposed or moisture-resistant element.

3. Efficiency, maintenance, or safety of any operational element.

4. Visual qualities of sight exposed elements.

5. Work of Owner or separate Contractor.

1.08 EXISTING UTILITIES AND STRUCTURES

A. Contractor shall be responsible for injury or damages to any utility, mechanical equipment, electrical wiring and conduits, PA and Security Systems, buildings and other structures that may be met within the prosecution of the work. Contractor shall be liable for any damages to items resulting from work of this Contract. To include injury or damages caused by Subcontractors, sub-subcontractors and material manufacturers.

C. All existing utilities are NOT indicated on the drawings. Contractor to use caution during construction.

1.09 MANUFACTURER'S DIRECTIONS

A. It is intended that manufactured articles, materials, and equipment be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with manufacturer's printed directions unless specifically specified to contrary.

B. If there is a conflict between the Contract Documents and manufacturer's directions, the Contractor shall notify the Architect in writing. Contractor shall not proceed with work until Architect has reviewed the conflicting data and provide the Contractor with a decision on which specification to follow.

1.10 GENERAL SPECIFICATION NOTE

A. The paragraph entitled "WORK INCLUDED" in each section of the technical section shall be considered general in nature and NOT all inclusive. The intent of the paragraph is to provide a general guide of what is included in the section.

B. The paragraph entitled "RELATED WORK" in each section of the technical section shall be considered general in nature and NOT all-inclusive. The intent of the paragraph is to provide a general guide of what is included in the section.

PART 2 PRODUCTS

2.01 MATERIALS (CUTTING & PATCHING)

A. Primary Products: Those required for original installation.

B. Product Substitution: For any proposed change in materials, submit request for substitution under provisions of Section 01 60 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.

B. After uncovering existing work, inspect conditions affecting performance of Work.

C. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Provide all required temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.

B. Provide protection from elements for areas, which may be exposed by uncovering work.

3.03 CUTTING AND PATCHING

A. Execute cutting, fitting, and patching and fill to complete work.

B. Fit products together, to integrate with other work.

C. Uncover work to install ill-timed work.

D. Remove and replace defective or non-conforming work.

E. Remove samples of installed work for testing.

F. Provide openings in the Work for penetration of mechanical and electrical work.

3.04 PERFORMANCE

A. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.

B. Cut rigid materials using saws or if approved by Owner, acetylene torches.

C. Restore work with new Products in accordance with requirements of Contract Documents.

D. Fit work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.

E. Refinish all surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

END OF SECTION 01 30 00

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. Requests for Information (RFIs).
3. Project meetings.

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

C. Related Requirements:

1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.
3. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.3 DEFINITIONS

A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 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, and telephone number 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 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 and telephone numbers, including home, office, and 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.

1.5 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, which 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.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Conservation: Coordinate construction activities to ensure that operations are carried out 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.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown 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 the coordination drawings by multiple contractors 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 the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance

requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

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 subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures 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. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. 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.

7. 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, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that 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 so inform Contractor, who shall make changes as directed and resubmit.

1.7 REQUESTS FOR INFORMATION (RFIs)

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

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Frivolous RFIs: RFIs generated by the contractor because of his failure to adequately study and compare the Contract Documents, or coordinating their own work, shall be considered frivolous. The contractor shall pay all A/E and owner costs associated with responding to these RFIs.

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

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. 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.

D. RFI Forms: AIA Document G716 or another form that in the sole opinion of the Architect is acceptable.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

E. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days plus seven days for consultants 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. Frivolous, iIncomplete 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 of additional information.

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

F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect
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.

G. 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 five days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, 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.
3. Agenda: Discuss items of significance that could affect progress, including the following:

a. Tentative construction schedule.
b. Phasing.
c. Critical work sequencing and long-lead items.
d. Designation of key personnel and their duties.
e. Lines of communications.
f. Procedures for processing field decisions and Change Orders.
g. Procedures for RFIs.
h. Procedures for testing and inspecting.
i. Procedures for processing Applications for Payment.
j. Distribution of the Contract Documents.

k. Submittal procedures.
l. Preparation of record documents.
m. Use of the premises and existing building.
n. Work restrictions.
o. Working hours.
p. Owner's occupancy requirements.
q. Responsibility for temporary facilities and controls.
r. Procedures for moisture and mold control.
s. Procedures for disruptions and shutdowns.
t. Construction waste management and recycling.
u. Parking availability.
v. Office, work, and storage areas.
w. Equipment deliveries and priorities.
x. First aid.
y. Security.
z. Progress cleaning.

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

C. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 30 days prior to the scheduled date of Substantial Completion.

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

a. Preparation of record documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Submittal of written warranties.
d. Requirements for preparing operations and maintenance data.
e. Requirements for delivery of material samples, attic stock, and spare parts.
f. Requirements for demonstration and training.
g. Preparation of Contractor's punch list.
h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
i. Submittal procedures.
j. Responsibility for removing temporary facilities and controls.

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

D. Progress Meetings: Conduct progress meetings at weekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, 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 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) Review schedule for next period.

   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 utilization.
      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: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

1.9 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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

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. Contractor's construction schedule.
2. Construction schedule updating reports.
3. Daily construction reports.
4. Site condition reports.
5. Special reports.

B. Related Requirements:

1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
2. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Event: The starting or ending point of an activity.

1.4 INFORMATIONAL SUBMITTALS

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

1. PDF electronic file.

B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

C. Construction Schedule Updating Reports: Submit with preliminary (pencil copy) Applications for Payment.

D. Daily Construction Reports: Submit at weekly intervals.

E. Site Condition Reports: Submit at time of discovery of differing conditions.

F. Special Reports: Submit at time of unusual event.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.

4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with site use limitations.
    b. Limitations of continued occupancies of adjacent buildings.
    c. Uninterruptible services.
    d. Use of premises restrictions.
    e. Environmental control.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.
    j. Adjusting.
    k. Curing.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, final completion, and the following interim milestones:

1. Temporary enclosure and space conditioning.
2. North parking lot access roadway completion.

E. Recovery Schedule: When periodic update indicates the Work is 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.

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

1. Use Microsoft Project for Windows XP operating system.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice of Award. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require two months or longer to complete, indicate an estimated completion percentage in 5 percent increments within time bar.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within two day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

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.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Division 01 Section "Project Management and Coordination" for submitting Contractor's construction schedule.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.

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.

1.3 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.

B. Architect will not process or review submittals that have not been reviewed by the Contractor or that do not have the Contractor’s review / approval stamp on them.

C. Submittals received by Architect after 12:00 p.m. will be considered as received the following working day.

D. 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. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

E. 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 15 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.

    a. Allow additional 5 days for review of each submittal where it is necessary for review by Architect or Owner consultant.

2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.

    a. Allow additional 5 days for review of each submittal where it is necessary for review by Architect or Owner consultant.

F. Paper Submittals: Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information for processing and recording action taken:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Name of subcontractor.
    g. Name of supplier.
    h. Name of manufacturer.
    i. Submittal number or other unique identifier, including revision identifier.

        1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alph numereic suffix (e.g., 061000.01R1).

    j. Number and title of appropriate Specification Section.
    k. Drawing number and detail references, as appropriate.
    l. Location(s) where product is to be installed, as appropriate.
    m. Other necessary identification.

4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.

    a. Transmittal Form for Paper Submittals: Use AIA Document G810.
    b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:

        1) Project name.
        2) Date.
        3) Destination (To:).
        4) Source (From:).
        5) Name and address of Architect.

6) Name of Construction Manager.
7) Name of Contractor.
8) Name of firm or entity that prepared submittal.
9) Names of subcontractor, manufacturer, and supplier.
10) Category and type of submittal.
11) Submittal purpose and description.
12) Specification Section number and title.
13) Specification paragraph number or drawing designation and generic name for each of multiple items.
14) Drawing number and detail references, as appropriate.
15) Indication of full or partial submittal.
16) Transmittal number, numbered consecutively.
17) Submittal and transmittal distribution record.
18) Remarks.
19) Signature of transmitter.

G. Options: Identify options requiring selection by Architect.

H. Deviations: Identify deviations from the Contract Documents on submittals.

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

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

J. 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.

K. 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.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

1. Action Submittals: Submit five paper copies of each submittal unless otherwise indicated. Architect will return two copies.
2. Informational Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will not return copies.
3. Certificates and Certifications Submittals: Provide 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.

a. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. 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 not suitable 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.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams showing factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

    a. Five paper copies of Product Data unless otherwise indicated. Architect will return two copies.

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.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).
3. Submit Shop Drawings in the following format:

    a. Five opaque copies of each submittal. Architect will retain three copies; remainder will be returned.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of applicable Specification Section.

3. 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.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. 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 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.

5. 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 sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three 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:

1. Submit product schedule in the following format:

a. Four paper copies of product schedule or list unless otherwise indicated. Architect will return two copies.

F. Coordination Drawings Submittals: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Division 01 Section "Summary."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

L. 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.

M. 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.

N. 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.

O. 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.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. 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.

S. 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.

T. 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.

U. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."

V. 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.

W. 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.

X. 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.

2.2 DELEGATED-DESIGN SERVICES

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

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and five paper copies of certificate, 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.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action 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.

1. Contractor shall clearly identify ”any” and “all” deviations from the contract documents.
2. Contractor shall clearly identify items which need clarification with other trades than the trade submitting the submittal.
3. Contractor shall cleary identify “any” and “all” modifications to the contract documents required by the submittal.

B. Resubmittals shall have “all” changes, modifications , etc. clearly identified. Failure to identify changes, modifications, etc. shall be justification for returning the submittal without A/E review.

C. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "Closeout Procedures."

D. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

E. Failure of Contractor to properly review or stamp submittal shall be justification for returning the submittal without A/E review.

F. Contractor shall submit documents required by authorities having jurisdiction and obtain their approvals prior to submission to the Architect.

3.2 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

C. 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.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 33 00

SECTION 01 40 00 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

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

B. Testing and inspecting 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 -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. The contractor is responsible for the overall quality of all its own work and the work performed by the subcontractors working under this contract. The quality of any part of the work installed must not be less than that required by the contract documents. If the Architect or Owner determines that the quality of work does not conform to the applicable specifications and drawings, the contractor will be advised in writing of the areas of nonconformance and within 24 hours the contractor must correct the deficiencies and advise the Architect and Owner in writing of the corrective action taken.

D. Related Sections include the following:

1. Sections 02 through 33 for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, 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. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.

D. 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.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

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

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. 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, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five 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. If individual specification sections require a higher minimum experience requirement that requirement shall supersede this subparagraph.

1.4 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision 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.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data : For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by applicable building code, authorities having jurisdiction or the contract documents submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number 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 inspecting.
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 reinspecting.

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

1.7 QUALITY ASSURANCE

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

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. 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.

I. 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.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

J. Integrated Exterior Mockups: Construct integrated exterior mockup as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1.8 QUALITY CONTROL

A. Special Tests and Inspections: Owner will engage a qualified testing agency and special inspector to conduct special tests and inspections per the requirements of Chapter 17 of the Rhode Island State Building Code as the responsibility of the Owner as indicated in the Statement of Special Inspections attached to this Section and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.

C. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

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 Division 1 Section "Submittal Procedures."

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

1. All costs associated with retesting shall be the responsibility of the Contractor.

F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with Owner’s special inspector, testing agency and other agencies 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 inspecting. 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 inspecting equipment at Project site.

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

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.9 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency and special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner**,** as indicated in Statement of Special Inspections attached to this Section, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect**,** Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

1) Owner will furnish Contractor with names, addresses and phone numbers of special inspector and testing agencies engaged and a description of testing and inspecting they are engaged to perform.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. 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 modifications as they occur. Provide access to test and inspection log for Architect's and Owner’s Project Manager reference during normal working hours.

3.2 REPAIR AND PROTECTION

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

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

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 01 40 00

SECTION 01 81 19 – CONSTRUCTION INDOOR AIR QUALITY

PART 1 - GENERAL

1.1 CONSTRUCTION IAQ MANAGEMENT GOALS FOR THE PROJECT

A. The Owner has established that this Project shall minimize the detrimental impacts on Indoor Air Quality (IAQ) resulting from construction activities. Factors that contaminate indoor air, such as dust entering HVAC systems and ductwork, improper storage of materials on-site, poor housekeeping, shall be minimized.

1.2 SUMMARY

A. This Section includes requirements for the development of a Construction Indoor Air Quality Management Plan (alternately referred to as “the Plan”),

1. Develop the Plan for approval by the Owner and Architect.
2. The Plan shall be implemented throughout the duration of the project construction.
3. The Plan shall be documented as outlined in the Submittal Requirements of Paragraph 1.7 below.
4. The Plan is included as part of the LEED and NE-CHPS requirements for the project.

B. Related Sections:

1. All sections of the Specifications related to interior construction, MEP systems, and items affecting indoor air quality.
2. Section 099100 “Painting” for paint VOC contents.

1.3 DEFINITIONS

A. Volatile Organic Compounds (VOC’s):

1. Chemical compounds common in and emitted by many building products, including solvents in paints, coatings, adhesives and sealants, wood preservatives, composite wood binder, and foam insulations.
2. Not all VOC’s are harmful, but many of those contained within building products contribute to the formation of smog and irritate (at best) building occupants by their smell and/or health impact.

B. Materials that act as “sinks” for VOC contamination: Absorptive materials, typically dry and soft (such as textiles, carpeting, acoustical ceiling tiles and gypsum board) that readily absorb VOC’s emitted by “source” materials and release them over a prolonged period of time.

C. Materials that act as “sources” for VOC contamination: Products with high VOC contents that emit VOC’s either rapidly during application and curing (typically “wet” products, such as paints, sealants, adhesives, caulks and sealers) or over a prolonged period (typically “dry” products such as flooring coverings with plasticizers and engineered wood with formaldehyde).

1.4 REFERENCES, RESOURCES

A. "IAQ Guidelines for Occupied Buildings under Construction", First Edition, November 1995, The Sheet Metal and Air Conditioner Contractors National Association (SMACNA). (703) 803-2980, www.smacna.org.

B. ANSI/ASHRAE 52.2-1999, "Method of testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size", www.ashrae.org.

1.5 LEED and NE-CHPS GENERAL REQUIREMENTS

A. Implement practices and procedures to meet the project's environmental performance goals, which includes achieving LEED and NE-CHPS certification goals identified in this Contract. Specific project goals that may impact this area of work include:

1. Use of recycled-content materials.
2. Use of locally-manufactured materials.
3. Use of low-emitting materials
4. Use of certified wood products.
5. Construction waste recycling.
6. The implementation of a construction indoor air quality management plan.

B. Ensure that the requirements related to these goals, as defined in the sections below, are implemented to the fullest extent. Substitutions, or other changes to the work shall not be allowed if such changes substantially compromise the stated LEED and NE-CHPS Performance Criteria.

1.6 CONSTRUCTION IAQ MANAGEMENT PLAN

A. Prepare and submit a Construction IAQ Management Plan to the Owner for approval. The Construction IAQ Management Plan shall meet the following criteria:

1. Construction activities shall be planned to meet or exceed the minimum requirements of the Sheet Metal And Air Conditioning National Contractors' Association I(SMACNA) "IAQ Guidelines for Occupied Buildings under Construction", First Edition, 1995.

2. Absorptive materials shall be protected from moisture damage when stored on-site and after installation.

3. If air handlers are to be used during construction, filtration with a Minimum Efficiency Reporting Value (MERV) of 8 must be at each return air grill, as determined by ASHRAE 52.2-1999.

4. Filtration media shall be replaced immediately prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13 as determined by ASHRAE 52.2-1999.

5. A "Sequence of Finish Installation Plan" shall be developed, highlighting measures to reduce the absorption of VOC's by materials that act as "sinks".

6. Upon approval of the Plan by the Owner and Architect, it shall be implemented through the duration of the construction process, and documented in accordance with the Submittal Requirements of Paragraph 1.7 below.

7. After construction ends but before occupancy, comply with one of the following requirements:

a. Perform a building flushout with outside air.
b. Conduct IAQ testing for air contaminant levels in the building.

8. Prevent exposure of building systems to environmental tobacco smoke during construction. Smoking is prohibited on-site.

B. Further description of the Construction IAQ Management Plan requirements is as follows:

1. SMACNA Guidelines: Chapter 3 of the referenced “IAQ Guidelines for Occupied Buildings Under Construction”, outline IAQ measures in five categories as listed below. The Construction IAQ Management Plan shall be organized in accordance with the SMACNA format, and shall address measures to be implemented in each of the five categories (including subsections). All subsections shall be listed in the Plan, items that are not applicable for this project should be listed as such.

   a. HVAC Protection:
      1. Return Side.
      2. Central Filtration.
      3. Supply Side.
      4. Duct Cleaning.

   b. Source Control:

      1. Product Substitution.
      2. Modifying Equipment Operation.
      3. Changing Work Practices.
      4. Local exhaust.
      5. Air cleaning.
      6. Cover or seal.

   c. Pathway Interruption:

      1. Depressurize Work Area.
      2. Pressurize Occupied Space.
      3. Erect Barriers to Contain Construction Areas.
      4. Relocate Pollutant Sources.
      5. Temporarily Seal the Building.

   d. Housekeeping.

   e. Scheduling.

2. Protection of Materials from Moisture Damage: As part of the “Housekeeping” section of the Construction IAQ Management Plan, measures to prevent installed materials or material stored on-site from moisture damage shall be described. This Section should also describe measures to be taken if moisture damage does occur to absorptive materials during the course of construction.

3. Replacement of Filtration Media: Under the “HVAC Protection” section of the Construction IAQ Management Plan, a description of the filtration media in all ventilation equipment shall be provided. The description shall include replacement criteria for filtration media during construction, and confirmation of filtration media replacement for all equipment immediately prior to occupancy.

4. Sequence of Finish Installation for Materials: Where feasible, absorptive materials shall be installed after the installation of materials or finishes which have high short-term emissions of VOC’s, formaldhyde, particulates, or other air-borne compounds.

   a. Absorptive materials include, but are not limited to:

      1. Acoustical Ceiling panels.
      2. Insulations (exposed to the airstream)
      3. Other woven, fibrous or porous materials.

b. Materials with high short-term emissions include, but are limited to:

1. Adhesives.
2. Sealants and glazing compounds (specifically those with petrochemical vehicles or carriers).
3. Paints.
4. Wood preservatives and finishes.
5. Control and/or expansion joint fillers.
6. Hard finishes requiring adhesive installations.
7. Gypsum board (with associated finish processes and products).

5. Develop a separate sequencing plan that identifies feasible opportunities to meet the above stated goals for the project. The plan shall be submitted to the Architect and Owner in accordance with the Submittal Requirements of Paragraph 1.7 of this specification.

6. Implementation and Coordination: Implement the Construction IAQ Management Plan, and coordinate the Plan with all affected trades. Designate one individual as the Construction IAQ Representative, who will be responsible for communicating the progress of the Plan with the Owner and Architect on a regular basis, and for assembling the required LEED and NE-CHPS documentation. Include provisions in the Construction IAQ Management Plan for addressing conditions in the field that do not adhere to the Plan, including provisions to implement a stop work order, or to rectify non-compliant conditions.

1.7 SUBMITTALS

A. Submit the following LEED and NE-CHPS required records and documents:

1. A copy of the Construction IAQ Management Plan as defined in paragraph 1.7 of this paragraph.

2. The proposed IAQ Plan shall include, but not limited to, the following:

a. Protection of ventilation system components during construction.

b. Cleaning and replacing contaminated ventilation system components after construction, including filtration media.

c. Temporary ventilation.

d. Protection of absorptive materials from moisture damage when stored on-site and after installation, including exterior wall rain protection.

e. Sequence of finish installation plan.

f. Selection of cleaning products and procedures to be used during construction and final cleaning.

g. Other items as required by SMACNA IAQ Guidelines for Occupied Buildings under Construction, Chapter 3.

3. Product cut-sheets for all filtration media used during construction and installed immediately prior to occupancy, with MERV values highlighted. Cut sheets shall be submitted with the Contractor's or Subcontractor's 'approved' stamp as confirmation that the products are the products installed on the project.

4. Provide the Architect or Owner's Representative with a minimum of 12 photographs comprising of at least four photographs taken on three different occasions during construction. The photographs shall document the implementation of the Construction IAQ Management Plan throughout the course of the project construction. Examples

include photographs of ductwork sealing and protection, temporary ventilation measures, and conditions of on-site materials storage (to prevent moisture damage). Photographs shall be submitted with brief descriptions of the Construction IAQ Management Plan measure documented, or be referenced to project meeting minutes or similar project documents which reference to the Construction IAQ Management Plan measure documented.

5. Comply with the requirements of LEED IEQc3.1 and IEQc3.2.
6. Indoor Air Quality (IAQ) Data: Submit emission test data as required, with testing laboratory and date clearly identified.
7. Material Safety Data Sheets (MSDS): Submit for materials as required, with date clearly identified. MSDS must contain specific chemical content data identifying the percent of the total product mass represented by each listed chemical.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 81 19

SECTION 014533 – CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. The Latest Rhode Island State Building Code, under which this project is designed and will be built, requires the structural engineer of record (SER) to provide a program of structural tests and special inspections for this project in accordance with Chapter 17, 2018 International Building Code. The SER is the structural engineer who is in responsible charge of the preparation of the structural drawings and structural specifications for this project and whose Rhode Island professional engineering seal appears on said structural drawings.

B. The SER has prepared a document entitled Statement of Special Inspection, which has been or will be submitted to the building official who has jurisdiction over this project, with the application for a building permit.

C. The program of structural tests and inspections shall not relieve the Contractor or its subcontractors of their responsibilities and obligations for quality control of the work, their other obligations of supervising the work, for any design work which is included in their scope of services, and for full compliance with the requirement of the Contract Documents. Furthermore, the detection of, or failure to detect, deficiencies or defects in the Work during the testing and inspection conducted pursuant to the program shall not relieve the Contractor or its subcontractor of their responsibility to correct all deficiencies or defects, whether detects or undetected, in all parts of the Work, and to otherwise comply with all requirements of the Contract Documents.

D. The program of structural tests and inspection does not apply to the Contractor’s equipment, temporary structures used by the Contractor to construct the project, the Contractor’s means, methods, and procedures, and job site safety.

E. The structural testing and special inspection required by this Section is in addition to the inspections required by the Building Officials. Special inspection is not a substitute for inspection by a local municipal building inspector. Specially inspected work which is installed or covered without the approval of the Engineer or local municipal building inspector is subject to removal or exposure.

F. The Owner shall employ the Special Inspectors or approved Testing Agencies.

G. Special Inspector shall be an independently established and recognized agency regularly engaged in conducting tests or furnishing professional and inspection services and shall be approved by the Building Official and/or SER. The agency shall disclose all possible conflicts of interest so that objectivity can be confirmed. The agency shall have adequate equipment to perform all required tests. Personnel performing special inspection activities shall have qualifications according to the requirements for special inspector as noted below.

H. Special Inspectors as selected and approved by the Building Official and SER shall:

1. Be a qualified person, who shall have the minimum qualifications indicated in the Statement of Special Inspection, and demonstrate competence, to the satisfaction of the Building Official and SER, for inspection of the particular type of construction or operation requiring special inspection.
2. Be under the supervision of a professional engineer registered in the state in which work is under construction.

3. Observe the work assigned for conformance with the approved Drawings and Specifications and shall keep records of inspections or tests. The work inspected or tested shall be clearly identified, deficiencies noted, and resolutions stated.
4. Furnish inspection reports to the Architect, SER, Construction Manager/General Contractor, Owner, and the Building Official. Reports shall indicate that work inspected was done in conformance with approved construction documents. Discrepancies shall be brought to the immediate attention of the Contractor for correction, then, if uncorrected, the attention of the Building Official and SER prior to completion of that phase of work.
5. Submit a final signed report stating the work was in conformance with the approved Drawings and Specifications and the applicable workmanship provisions of the governing state code.

I. Special Inspector shall review this specification and Chapter 17 of the International Building Code. In the event of conflict with this specification and the Building Code, the Code shall govern.

1.2 CONTRACTORS RESPONSIBILITIES

A. Where the document Statement of Special Inspections indicates that a structural component or system is subject to structural tests and inspections by Chapter 17, 2018 International Building Code and that the SER for the project has not been retained to design said component or system or to prepare a performance specification for said component system, and the Architect has not otherwise provided for the structural design of said component or system, the Contractor shall retain, or require others under his direction to retain, a professional engineer registered in Rhode Island to design said component or system and to provide the required program of structural tests and inspections for said component or system.

B. The Contractor shall provide free and safe access to the Work for the SER and all other individuals who are observing the work or performing structural tests or inspections. The Contractor shall provide all ladders, scaffolding, staging, and up-to-date safety equipment, all in good and safe working order, and qualified personnel to handle and erect them, as may be required for safe access.

C. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was the Contractor’s responsibility.

1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor’s responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.

END OF SECTION 014533

SECTION 01 50 00 - 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.

B. Related Requirements:

1. Division 01 Section "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

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

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups and staging areas.

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

C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
3. Indicate sequencing of work that requires water and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

1.5 QUALITY ASSURANCE

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

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility if neede 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. 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 bases for supporting posts.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.

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

1. Store combustible materials apart from building.

2.3 EQUIPMENT

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

PART 3 - EXECUTION

3.1 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.

1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."

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.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: If required to perform construction, install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

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

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

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

D. Sanitary Facilities: Provide temporary toilets, wash 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.

E. 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.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

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

H. 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.
2. Install lighting for Project identification sign.

I. Telephone Service: Provide temporary telephone and fax service in common-use facilities for use by all construction personnel. Install two telephone line(s) for each field office.

1. At each telephone, post a list of important telephone numbers.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.

e. Architect's office.
f. Engineers' offices.
g. Owner's office.
h. Principal subcontractors' field and home offices.

2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices and storage sheds, if required, located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. 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. Temporary Use of Paved Areas:

1. Protect existing site including curbs, pavement, and utilities at all times.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Onsite parking is available. Contractor shall coordinate with PHA the use of temporary parking areas for construction personnel.

D. Project Signs: Provide Project signs as indicated. 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 and the adjacent buildings.

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

2. Maintain and touchup signs so they are legible at all times.

E. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

F. 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.

2. Temporary Elevator Use: The possible use of building elevators shall be coordinated with the PHA.

3. Do not load elevators beyond their rated weight capacity.

4. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

G. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

H. Hoisting Facilities

1. Provide hoisting facilities as required for the vertical movement of all materials.
2. Comply with OSHA for all hoists, conveyers, and elevators and maintain the facilities in compliance with the law.

I. Scaffolding and Staging

1. Contractor shall furnish erect and maintain exterior staging, scaffolding and protections of public walkways for use during construction of building. Each subcontractor shall furnish, erect and maintain staging and scaffolding required in work under his subcontract. Staging shall conform to federal, state, and local requirements. On completion of his work, each subcontractor shall dismantle and remove his staging and scaffolding.

3.4 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.

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.

1. Comply with work restrictions specified in Division 01 Section "Summary."

C. 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.

D. 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 environmentally safe materials.

E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals 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. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

F. 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 work day.

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

H. Temporary Egress: Maintain temporary egress from existing occupied facilities as required by authorities having jurisdiction.

I. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.

1. Construct covered walkways using scaffold or shoring framing.
2. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
3. Maintain appearance of walkway for duration of the Work.

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.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

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.
2. Supervise the use of combustion-type temporary heating units and similar sources of fire ignition according to 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.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: 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 Phase: 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 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, replace, or clean stored or installed material that begins to grow mold.

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

3.6 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.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. 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.

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

D. 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.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Repair or replace street paving, curbs, and sidewalks, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 01 50 00

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; comparable products and substitutions.

B. Related Requirements:

1. Division 01 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, which 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 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 specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

C. 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. Comparable Product Requests: Submit request for consideration of each comparable product. Identify 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 one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

    a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
    b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

C. 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 CSI Form 13.1A or another form that is acceptable to the Architect.

2. Form shall be sent to Architect in both hardcopy and electronic file form so that Architect may respond back to Contractor electronically.
3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

    a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    b. Coordination 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 substitution 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 and 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 building code in effect for Project, from ICC-ES.
    j. Detailed comparison of Contractor's construction schedule using proposed substitution 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.

4. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.

b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

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.

1.6 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 to determine that products are undamaged and properly protected.

C. Storage:

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

6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 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 Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

1.8 SUBSTITUTIONS

A. Limitations on substitutions:

1. During Bidding period, Instructions to Bidders govern times for submitting requests for substitutions under requirements specified in this Section.
2. Substitutions will not be considered when indicated on shop drawings or product data submittals without separate formal request, when requested directly by subcontractor or supplier, or when acceptance will require substantial revision of Contract Documents.
3. Substitute products shall not be ordered or installed without written acceptance.
4. Only one request for substitution for each product will be considered. When substitution is not accepted, provide specified product.
5. Architect has sole right of determination of acceptability of substitutions.
6. A contractor or subcontractor who carries the cost of a substitute in his bid without prior review by the Architect, does so at his own risk. The Owner is no way obligated to review nor allow that a speculative substitution be furnished.

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 not in conflict with 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 "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

    a. 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 not be considered unless otherwise indicated.

4. Manufacturers:

    a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

5. 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 Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or 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.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: 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 the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

2.3 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 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. Requested substitution provides sustainable design characteristics that specified product provided.
c. Substitution request is fully documented and properly submitted.
d. Requested substitution will not adversely affect Contractor's construction schedule.
e. Requested substitution has received necessary approvals of authorities having jurisdiction.
f. Requested substitution is compatible with other portions of the Work.
g. Requested substitution has been coordinated with other portions of the Work.
h. Requested substitution provides specified warranty.
i. 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: Architect will consider requests for substitution if received within 30 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.

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 offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include

compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Requested substitution provides sustainable design characteristics that specified product provided.
e. Substitution request is fully documented and properly submitted.
f. Requested substitution will not adversely affect Contractor's construction schedule.
g. Requested substitution has received necessary approvals of authorities having jurisdiction.
h. Requested substitution is compatible with other portions of the Work.
i. Requested substitution has been coordinated with other portions of the Work.
j. Requested substitution provides specified warranty.
k. 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.

2.4 MANUFACTURER'S INSTRUCTIONS

A. When contract documents require installation of work to comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to the Owner's Representative. Maintain one copy of the instructions at the job site until project completion.

B. Should project conditions, drawings or specification requirements conflict with manufacturer's instructions the Contractor shall advise the Architect for further instructions, prior to commencement of the work.

C. Perform all work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure. If there are any conflicts with the contract documents notify the Architect prior to proceeding with the work.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

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. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

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

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

1.4 INFORMATIONAL SUBMITTALS

A. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 QUALITY ASSURANCE

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

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut

and patch structural elements in a manner that could change their load-carrying capacity or increase deflection

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

4. 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.

B. 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.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

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, mechanical and electrical systems, 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 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 and Contractor promptly.

B. General: Engage a land surveyor or professional engineer 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. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. 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. 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.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

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.
4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
5. Contractor shall not install Work so as to require a lowering of ceiling heights without approval of the Archtitect.

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: Do not use tools or equipment that produce harmful 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 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. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

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. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

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

D. 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.

E. 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.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

F. 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.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

G. 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 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 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.

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. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

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 assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements of Owner's Commissioning Agent.

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

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

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

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

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

END OF SECTION 017300

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General 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. Related Requirements

1. Section 024119 “Selective Demolition” for disposal of waste resulting from partial demolition of building materials.

1.3 DEFINITIONS

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

B. Demolition Waste: Building materials resulting from selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

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.

1.4 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Construction Waste:

a. Lumber.
b. Wood sheet materials.

c. Metals.
d. Insulation.
e. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, 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) Plastic pails.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for the Notice of Award.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons (tonnes).
4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of site-preparation and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for site preparation waste. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for site preparation waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
2. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
4. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-5 for construction waste and Form CWM-6 for site preparation waste. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.

3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in hauling and tipping fees by donating materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Division 01 Section "Temporary Facilities and Controls."

B. 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 three 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.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

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

3.3 RECYCLING 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.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Contractor's Option: As this construction site is very limited in area the use of c co-mingled collection system with off site separation is acceptable.
2. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

3. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
4. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
5. Store components off the ground and protect from the weather.
6. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 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.

3.5 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, 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. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 01 74 19

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. Division 01 Section "Execution" for progress cleaning of Project site.
2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
5. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

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.

D. Certificate Of Occupancy from the authorities having jurisdiction.

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 21 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 Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Divisions 02 through 33 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 where applicable.

    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 Architect's signature for receipt of submittals.

5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of **21** 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.
6. Advise Owner of changeover in heat and other utilities.
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, including touchup painting.
10. Touch up 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 21 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, that must be completed or corrected before certificate will be issued.

1. Reinspection: 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 Division 01 Section "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.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 14 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. Reinspection: 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. Use CSI Form 14.1A.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

a. MS Excel electronic file. Architect will return annotated file.
b. PDF electronic file. This file is for record purposes.

1.9 SUBMITTAL OF PROJECT WARRANTIES

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

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

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.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

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

1.10 RE-INSPECTION FEES

A. Should Architect perform re-inspections due to failure of the work to comply with the claims or status of completion made by the Contractor:

1. Owner will compensate the Architect for such additional services.

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 neither planted nor 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. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. 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.
k. Remove labels that are not permanent.
l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. 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 Standard 1992-01. Provide written report on completion of cleaning.

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

C. Pest Control: Comply with pest control requirements in Division 01 Section "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."

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 01 77 00

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.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

B. Related Requirements:

1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

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. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed 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 operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

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

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
b. Enable inserted reviewer comments on draft submittals.

2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. 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.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

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."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: 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. 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: Enable bookmarking of 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.

F. 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, 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.
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, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. 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.

C. 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.

D. 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.

2.4 OPERATION MANUALS

A. 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.

B. 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.

C. 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.

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

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

2.5 PRODUCT MAINTENANCE MANUALS

A. 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.

B. 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.

C. 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.

D. 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.

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

F. 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.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. 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 warranty and bond information, as described below.

B. 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.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
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.

D. 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.

E. 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.

F. 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.

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

H. 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 3 - EXECUTION

3.1 MANUAL PREPARATION

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

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

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.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, 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.

1. 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.

E. 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 operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Division 01 Section "Project Record Documents."

F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 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.

B. Related Requirements:

1. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
2. Divisions 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

1.2 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 set 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 and two 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 one paper copy of each submittal.

PART 2 - PRODUCTS

2.1 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. Record data as soon as possible after obtaining it.
    c. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

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

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

2.2 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. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

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

2.3 RECORD PRODUCT DATA

A. 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.

B. Format: Submit record Product Data as annotated PDF electronic file.

2.4 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.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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. Maintenance of Record Documents and Samples: Store record documents and Samples 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.

END OF SECTION 01 78 39

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. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.

B. Related Requirements:

1. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.4 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.

PART 2 - PRODUCTS

2.1 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.

B. Training: Include instruction for the following as applicable to the system, equipment, or component:

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. Operations manuals.
    c. Maintenance manuals.
    d. Project record documents.
    e. Identification systems.
    f. Warranties and bonds.
    g. 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:

    a. Startup procedures.
    b. Equipment or system break-in procedures.
    c. Routine and normal operating instructions.
    d. Regulation and control procedures.
    e. Control sequences.
    f. Safety procedures.
    g. Instructions on stopping.
    h. Normal shutdown instructions.
    i. Operating procedures for emergencies.
    j. Operating procedures for system, subsystem, or equipment failure.
    k. Seasonal and weekend operating instructions.
    l. Required sequences for electric or electronic systems.
    m. Special operating instructions and procedures.

5. Adjustments: Include the following:

    a. Alignments.
    b. Checking adjustments.
    c. Noise and vibration adjustments.
    d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

    a. Diagnostic instructions.
    b. Test and inspection procedures.

7. 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.

8. 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.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation. Assemble documentation into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

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

   1. Owner will furnish Contractor with names and positions of participants.

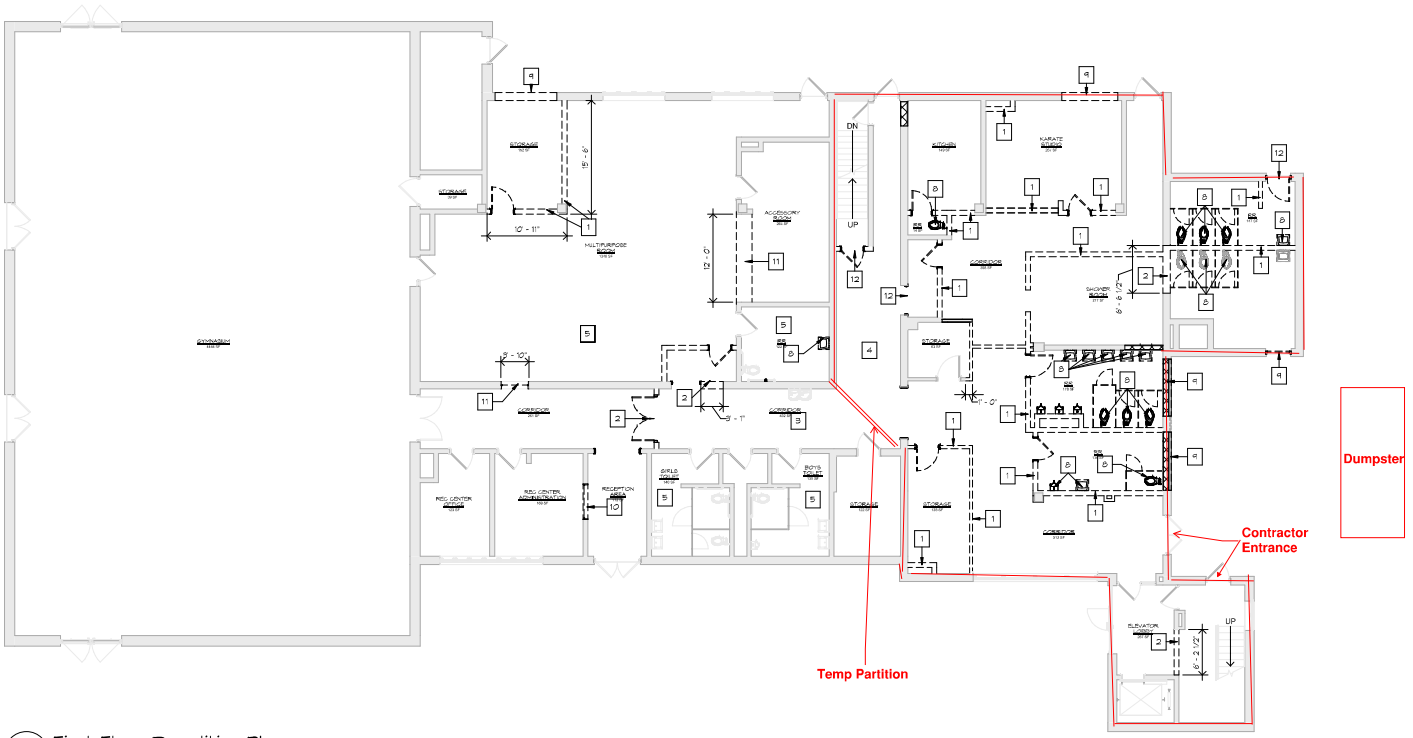
B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

   1. Schedule training with Owner, through Architect, with at least 21 days' advance notice.

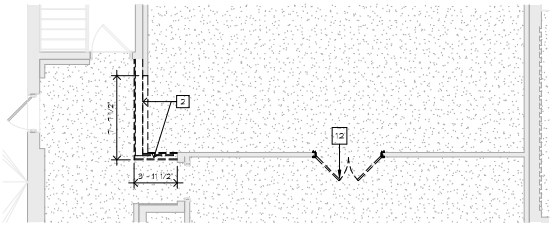
C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

D. Cleanup: Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01 79 00



1 D1.00 First Floor Demolition Plan
1/8" = 1'-0"



2 D1.00 Second Floor Partial Demolition Plan
3/16" = 1'-0"

DEMOLITION NOTES

1. REMOVE AND DISPOSE OF WALL ASSEMBLY IN ITS ENTIRETY, INCLUDING BUT NOT LIMITED TO ALL DOORS, FRAMES, AND TRIM, AS REQ'D FOR NEW WORK. REMOVE AND MAKE SAFE ALL ELECTRICAL COMPONENTS REQ'D FOR NEW WORK.
2. REMOVE AND DISPOSE OF PORTION OF EXISTING WALL ASSEMBLY, AS REQ'D FOR NEW WORK.
3. SHOT BLAST TO REMOVE EXISTING EPOXY FLOORING SYSTEM, INCLUDING ALL WALL BASE AS OCCURS, TO PREPARE SURFACE TO RECEIVE NEW FLOORING, PER MANUFACTURER'S RECOMMENDATIONS.
4. REMOVE AND DISPOSE OF EXISTING VCT AND VINYL WALL BASE AS OCCURS. PREPARE SURFACE TO RECEIVE NEW FLOORING, PER MANUFACTURER'S RECOMMENDATIONS.
5. REMOVE AND DISPOSE OF EXISTING CERAMIC TILE FLOORING ASSEMBLY. PREPARE SURFACE TO RECEIVE NEW FLOORING, PER MANUFACTURER'S RECOMMENDATIONS.
6. REMOVE AND DISPOSE OF EXISTING PLYWOOD CEILING ASSEMBLY. TEMPORARILY HANG AND SUPPORT ALL CONDUIT, PIPING, AND LIGHTING AS REQ'D FOR NEW WORK. PROVIDE TEMPORARY LIGHTING WHERE REQUIRED.
7. REMOVE AND DISPOSE OF EXISTING 2X2 ACT CEILING ASSEMBLY. REMOVE AND MAKE SAFE ALL EXISTING LIGHT FIXTURES.
8. REMOVE AND DISPOSE OF PLUMBING FIXTURES, TOILET ACCESSORIES, AND TOILET PARTITIONS IN ITS ENTIRETY. REFER TO PLUMBING DRAWINGS FOR ADDITIONAL INFORMATION.
9. REMOVE AND DISPOSE OF WINDOW IN FILLED MATERIAL, CONSISTING OF PLYWOOD AND MASONRY. PREPARE EXISTING OPENING TO RECEIVE NEW WINDOW.
10. REMOVE AND DISPOSE OF EXISTING INTERIOR RECEPTION WINDOW. PREPARE OPENING TO RECEIVE NEW COUNTER.
11. REMOVE AND DISPOSE OF EXISTING COUNTER AND WINDOW ASSEMBLY IN MULTIPURPOSE ROOM.
12. REMOVE AND DISPOSE OF EXISTING DOOR AND FRAME. PREPARE OPENING FOR NEW WORK AS REQ'D.
13. REMOVE EXISTING SCUPPER AND DOWNSPOUT.
14. REMOVE EXISTING EXHAUST FAN AND ROOF CURB.
15. REMOVE EXISTING VENTILATOR AND ROOF CURB.
16. REMOVE EXISTING DRAIN.
17. REMOVE EXISTING VENT STACK.
18. REMOVE AND SALVAGE EXIST ROOF HATCH ASSEMBLY FOR RE-INSTALLATION.
19. REMOVE EXISTING ROOF ASSEMBLY AND INSULATION IN ITS ENTIRETY TO EXISTING ROOF DECK AS OCCURS.

JOSLIN RECREATION CENTER - CPF RENOVATION

17 Hyatt St., Providence, RI 02903

Owner:
City of Providence, Dept. of Public Property
25 Dorrance Street
Providence, Rhode Island 02903

400 Massasoit Avenue
Suite 300, Second Floor
East Providence, Rhode Island
p. (401) 331-9200

2 Hampshire Street
Suite 109, First Floor
Foxboro, Massachusetts
p. (774) 215-0200

rowse@rowsearchitects.com

GENERAL NOTES

1. CONTRACTOR SHALL VISIT SITE, PRIOR TO BID, AND CAREFULLY INVESTIGATE AND EXAMINE THE AREA OF WORK SO AS TO SATISFY HIMSELF AS TO THE NATURE AND LOCATION OF THE WORK, CONTRACTOR TO NOTE THE CHARACTER, QUALITY, QUANTITIES OF MATERIALS REQUIRED AND DIFFICULTIES TO BE ENCOUNTERED, THE KIND AND EXTENT OF EQUIPMENT AND FACILITIES NEEDED FOR PERFORMANCE OF THE WORK AND OTHER ITEMS WHICH MAY, IN ANY WAY, AFFECT THE WORK OR CONTRACTOR'S PERFORMANCE.

2. DRAWINGS DO NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY.

Date: 04/08/2025
Drawn by: JMA **Proj. Mgr.:** BEG

Revisions

No.	Date	Description

FIRST FLOOR DEMOLITION PLAN

D1.00


William D'Abate Elementary
JOSLIN RECREATION CENTER AND...
Owner's Entrance
Construction Gate
Dumpster
Construction Fence
Owner's Access to Splash Pad

SECTION 024100 - SELECTIVE DEMOLITION

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. Demolition and removal of selected portions of existing building or structure.
2. Demolition and removal of selected site elements including concrete sidewalks, concrete curbing, concrete pads, and asphalt pavements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

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

1.3 DEFINITIONS

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

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition 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 PREINSTALLATION MEETINGS

A. Pre-demolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.

B. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

C. Pre-demolition Photographs or Video: Submit before Work begins.

1.7 CLOSEOUT SUBMITTALS

A. Landfill Records: Provide documentation as requested by Construction Manager.

1.8 FIELD CONDITIONS

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

B. Storage or sale of removed items or materials on-site is not permitted.

C. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PEFORMANCE 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/ASSE 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 record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off indicated utilities with utility companies.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

3.3 PREPARATION

A. 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.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Facilities: 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. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

C. Temporary Shoring: 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.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the 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, to minimize disturbance of adjacent surfaces. 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 fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area.
5. Protect items from damage during transport and storage.

C. 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 from damage during transport and storage.
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.

D. 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 during selective demolition[**and cleaned**] and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

E. Roofing: Remove no more existing roofing than necessary to accommodate new penetrations. Provide temporary protection for penetrations to maintain watertight and weather tight integrity until permanent patches are completed.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill or as otherwise directed by the Construction Manager.

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. 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.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 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.

END OF SECTION 024100

SECTION 051200 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. All of the Contract Documents, including General and Supplementary Conditions apply to the Work of this Section.

1.2 SCOPE

A. Provide structural steel and related appurtenances as indicated and specified. The term “Structural Steel” is used as defined in accordance with the AISC Code of Standard Practice. For steel decking systems, refer to the steel decking specification.

1.3 REFERENCES

A. American Institute of Steel Construction AISC:

1. Specification for Structural Steel Buildings
2. AISC Manual of Steel Construction, Allowable Strength Design.
3. AISC Code of Standard Practice for Steel Buildings and Bridges
4. AISC Specification for Structural Joints using High Strength Bolts approved by the Research Council on Structural Connections.
5. AISC Structural Steel Detailing Manual

B. American Welding Society AWS.

1. AWS D1.1: Structural Welding Code - Steel

C. Steel Structures Painting Council (SSPC) Surface Preparation Specifications

D. American Society for Testing and Materials (ASTM) Publications:

1. A 6/A 6M: Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
2. A 36/A36M: Specification for Carbon Structural Steel.
3. A 194/A 194M: Specification for Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service
4. A 307: Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
5. F3125: Specification for High Strength Structural Bolts, Steel Heat Treated, 120/150 ksi Minimum Tensile Strength
6. A 449: Specification for Quenched and Tempered Steel Bolts and Studs
7. A 563: Specification for Carbon and Alloy Steel Nuts
8. F 436: Specification for Hardened Steel Washers

1.4 DESIGN REQUIREMENTS

A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer

registered in the State of Rhode Island to prepare calculations, Shop Drawings, and other structural data for structural steel connections. Calculations shall be sealed by a professional engineer registered in the state of the project's location.

B. In accordance with the Code of Standard Practice, the Engineer in Responsible Charge of designing connections shall review and confirm in writing that the shop and erection drawings properly incorporate the connection designs, and the Fabricator shall provide a clear means by which the connection information is referenced to the related connections on the shop and erection drawings.

1.5 SUBMITTALS

A. Submit the following shop drawings:

1. Manufacturer's Literature: Provide manufacturer's literature describing standard items.
2. Shop drawings prepared under the supervision of a licensed Structural Engineer registered in Rhode Island showing materials, sizes, finishes, locations, attached hardware and fittings, designs of connections not specifically shown on the drawings, and details for manufactured items and fabricated metalwork, including field erection details showing cuts, copes, connections, holes, thread fasteners and welds. Indicate welds, both shop and field, by symbols conforming to AWS standards. Indicate coatings or other protection against corrosion.
3. Setting diagrams, erection plans, templates, and directions for installation of backing plates, anchors, and other similar items.
4. Material compliance certification with standards designated.
5. Samples of materials proposed for use.
6. Test reports conducted on shop and field bolted and welded connections. Include data on type(s) of tests conducted and test results.
7. Certified copy of each survey conducted by a licensed Land Surveyor showing elevations and locations of base plates and anchor bolts to receive structural steel and final elevations and locations of major structural elements. Indicate discrepancies between actual installation and contract drawings.
8. Mill Certificates: Provide certificates signed by manufacturers certifying compliance of materials with standards designated.
9. Welding Certificates: Submit copies of certificates for welding personnel and procedure for each type of weld prior to welding.
10. The Contractor shall maintain records of test results of welding procedures and records of welders employed, date of qualification, and identification symbol or mark. Such records shall be available for examination by the Structural Engineer of Record and testing agency or submit certified copies.

1.6 QUALITY ASSURANCE

A. Tolerances:

1. Maintain tolerances conforming to AISC Code of Standard Practice.
2. Permissible variation tolerances conforming to ASTM A 6.

B. Tension Calibrator:

1. Employ an independent testing laboratory to calibrate and confirm the accuracy of the tension-measuring device when slip-critical connections and connections subject to direct tension are being used.
2. The calibrating device for setting calibrated torque wrenches shall be checked for accuracy by quality personnel not more than 30 days prior to its first use on the project, and at intervals not more than six months thereafter.

3. If the Engineer has reason to question the accuracy of the calibrating device, he may require that it be returned to the manufacturer for certification of its accuracy.
4. Provide tension calibrator measuring device at the job site when high-strength bolts in slip-critical connections and connections subject to direct tension are being installed and tightened.
5. Frequency and number of confirmation tests to be performed and the test procedure to be employed to conform to the AISC/RCSC Specification for Structural Joints using High Strength Bolts.
6. Return tension calibrator measuring device to the independent laboratory for certification if the Engineer questions its accuracy.
7. Use the tension calibrator-measuring device to tighten high-strength bolts in slip-critical connections and connections subject to direct tension in conformance with Table 051200-1 (Section 8 AISC/RCSC Specification for Structural Joints using High Strength Bolts).

TABLE 051200-1.

Fastener Tension Required for Slip-Critical Connections and Connections Subject to Direct Tension

Nominal Bolt Size (inches)	Minimum Tension	
	Grade A325 Bolts (kips)	Grade A490 Bolts (kips)
½	12	15
5/8	19	24
¾	28	35
7/8	39	49
1	51	64
1 1/8	56	80
1 ¼	71	102
1 3/8	85	121
1 ½	103	148

C. Fabricator Qualifications:

1. Engage a firm experienced in fabricating structural steel similar to that indicated for this project and with a record of successful in-service performance, as well as, sufficient production capacity to fabricate structural steel without delaying the work.
2. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:

   a. Category: Standard for Steel Building Structures (STD).
   b. Fabricator shall be registered with and approved by authorities having jurisdiction.

D. Welding Qualification and Certification

1. Furnish written welding procedure for all welds in conformance with AWS Structural Welding Code.
2. Each welder, tacker and welding operator shall be certified by test within the past six months to perform type of work required in conformance with AWS Structural Welding Code. Testing shall be conducted and witnessed by an independent testing laboratory.
3. Maintain duplicate qualification and certifications records at the job site readily available for examination.

E. Test and Inspection

1. Inspection, Testing and Quality Control: A statement of special inspections will be established by the registered design professional in responsible charge who will prepare a

schedule of tests to be carried out by an independent testing agency. All costs for inspection and testing shall be borne by the Owner.

2. The materials and workmanship to be finished under this Section shall be subject to inspection and testing in the mill, shop, and field by the Registered design professional in responsible charge and/or Testing Agency. Such inspection and testing shall not relieve the contractor of his responsibility to perform his own inspection and quality control and to furnish materials and workmanship in accordance with the requirements of the contract documents.
3. The Contractor and Testing Agency shall examine the contract documents and become thoroughly acquainted with detailed inspection and testing requirements as outlined by the Registered design professional in responsible charge.
4. The Contractor shall cooperate with and facilitate inspection and testing by the Registered design professional in responsible charge and/or Testing Agency. The Contractor shall, at his own expense, furnish the registered design professional in responsible charge and/or the Testing Agency upon request, with the following:

    a. A complete set of reviewed erection drawings, detailed shop drawings, schedules, and corrective work procedures at the fabricating shop or shops in the field.
    b. Cutting list, order lists, material bills, and shipping lists.
    c. Information as to time and place of all rollings and shipment of material to shops.
    d. Representative sample pieces requested for testing.
    e. Assistance for testing materials and proper facilities for inspection of the work, in the mill, shop, and field.
5. The Testing Agency shall inspect and test, as required by the registered design professional in responsible charge, all welded and bolted work.
    a. Shop-Bolted Connections: Inspect or test in accordance with AISC Specifications.

    b. Shop Welding: Inspect and test during fabrication of structural steel assembled, as follows:
        1) Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
        2) Perform visual inspections of all welds.
        3) Perform test welds as follows. Inspection procedures listed are to be used at Contractor’s option.
            a) Liquid Penetrate Inspection: ASTM E 165
            b) Magnetic particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not acceptable.
            c) Radiographic Inspection: ASTM E94; minimum qualify level “2-2T.”
            d) Ultrasonic Inspection ASTM E 164.

6. Weldments and bolted connections that are required by the registered design professional in responsible charge and/or the Testing Agency to be corrected shall be corrected without delay at the Contractor’s expense and to the satisfaction of the registered design professional in responsible charge of the Testing Agency shall require drawings showing proposed corrective work to be submitted for review.
7. Any material or workmanship which is rejected by the registered design professional in responsible charge and/or the Testing Agency either in the mill, shop, or field shall be replaced promptly by the Contractor to the satisfaction of the registered design professional in responsible charge and/or the Testing Agency.
8. The fact that steel work has been accepted at the shop shall not prevent its final rejection at the job site, even after it has been erected, if found to be defective in any way.

1.7 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with the general equipment stipulations section and as specified herein.

B. The General Contractor, Sub-Contractors, and suppliers are all individually to furnish their own staging, scaffolding, and hoisting equipment necessary to get workers, materials, and equipment from the point of delivery at the project site to the point of use or installation within the building and project site. All crane and rigging services are the responsibility of each individual trade.

C. Identify and match-mark, materials, items and fabrications, for installation and field assembly.

D. Deliver items to job site as complete units, wherever practicable, ready for installation or erection, with anchors, hangers, fasteners and miscellaneous metal items required for installation. Items shall be delivered at such intervals to ensure uninterrupted progress of work.

E. Carefully handle and store materials, protected from weather, high heat, rusting corrosion and other damage.

F. Store material off the ground using pallets, platforms, or other useable supports with webs of flanged shapes vertical. Materials shall be stored to allow easy access for inspection and identification. Cover and protect steel from erosion and deterioration from snow, rain, and ground splatter.

G. Ship small parts, such as rivets, bolts, nuts, washers, pins, fillers, and small connecting plates and anchors, in boxes crates, or barrels. Pack separately each length and diameter of bolt and each size of nut and washer. Plainly mark and itemized list and description of the contents on the outside of each container. If bolts and nuts become dry and rusty, clean and relubricate before use.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

A. Structural Steel Shapes:

1. High-Strength, Low-Alloy Steel: ASTM A 992 (ASTM A992M), Grade 50.

B. Miscellaneous Plates and Bars:

1. Carbon Steel: ASTM A 36 (ASTM A36M).

C. Cold-Formed Steel Tubing: ASTM A500, Grade B.

1. Items to be galvanized shall be hot-dip galvanized after fabrication in accordance with ASTM A123 or ASTM A153 as applicable.

2.2 FASTENERS

A. Carbon Steel Bolts, Nuts and Washers: ASTM A 307, Grade A.

B. High-Strength Carbon Steel Bolts, Nuts and Washers: ASTM F3125, Grade A325, Type 1.

C. Hot-Dipped Galvanized Bolts, Nuts, and Washers in conformance with ASTM A 153 and A 385.

1. High-strength carbon steel bolts, Type 1.
2. Grade DH, ASTM A 563 or Grade 2H, ASTM A 194 nuts.
3. Hardened washers in conformance with ASTM F 436.
4. Bees wax lubrication for threaded parts of bolts and nuts.

5. Purchase bolts, nuts and washers from a single supplier.

D. Do not use high-strength tension control bolts when bolts are galvanized.

2.3 WELDING

A. Class E70XX electrodes.

B. Provide equipment for welding, electrodes, welding wire and fluxes capable of producing indicated welds when used by certified welders under AWS welding procedures. Provide welding materials that comply with requirements of AWS Structural Welding Code.

2.4 PRIMERS

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another. GC shall submit certification demonstrating compatibility.

B. Primer: Comply with Division 9 painting Sections. Apply in accordance with manufacturer’s written instructions and recommendations.

2.5 GALVANIZING REPAIR PAINT

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 FABRICATION

A. Fabricate each element and connection as indicated on the fabrication shop drawings approved by the Engineer. Fabricate and shop assemble work to the greatest extent practical in conformance with the following publications:

1. AISC Manual
2. AISC Specification for Structural Joints
3. AISC Detailing Manual
4. AWS Structural Welding Code

B. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.

C. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings burrs, and other defects.

D. Ensure that shearing, manual flame cutting with mechanically guided torch and chipping will not induce residual stress in metal being cut the Radii of re-entrant corners shall not be less than ¾ inch and perform flame cutting so that metal being cut is not carrying stress. Finish exposed edges.

E. Fabricate bearing stiffeners and stiffeners intended as supports for concentrated loads as indicated. Mill or grind bearing surfaces at stiffener ends.

F. Ensure full cross section bearing on milled ends of columns, crane rails, monorails and bearing stiffeners.

G. Connections: Weld or bolt shop connections, as indicated. Bolt field connections, except where welded connections or other connections are indicated.

1. Provide high strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.
2. Provide unfinished threaded fasteners for only bolted connections of secondary framing members to primary members (including purlins, girts, and other framing members taking only nominal stresses) and for temporary bracing to facilitate erection.

H. Connect all members with ASTM F3125 Grade A325 high strength bolts unless otherwise indicated or specified. Install in accordance with AISC/RCSC “Specification for Structural Joints using High Strength Bolts”. Provide holes without torn or ragged edges and remove all outside burrs.

I. Welded Connections:

1. Connections indicated or specified shall be welded in accordance with AWS D1.1.
2. Provide complete weather seal weldments made with 1/16-inch minimum continuous fillets to all members having Type S and E service and to all welded connections that will be galvanized.

J. Weld or bolt shop connections in conformance with specified AWS Structural Welding Code and AISC publications.

K. Provide ASTM A 36 anchor bolts with washer and heavy hex nuts. Provide hot-dip galvanized anchor bolts, washers and heavy hex nuts with galvanized steel.

L. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on final shop drawings.

M. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.

N. Cut, drill or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes for bearing plates.

O. Corrective Work: Structural steel members or assemblages having fabrication errors, which exceed permissible tolerances, shall be corrected only if permitted by the SER. All corrective work shall be in accordance with AISC and AWS requirements. When requested by the SER or Testing Agency, the Contractor shall submit to the Architect and/or SER for approval, drawings showing details of proposed corrective work and shall receive approved drawing prior to performing the corrective work. All corrective work shall be solely at the Contractor’s expense.

3.2 ERECTION

A. Survey: GC shall employ a licensed Land Surveyor for accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceed. Report any discrepancies to the Architect and SER and do no proceed with erection until corrections have been made or until adjustments to the structural steel work has been agreed upon by the Architect and SER.

B. Prior to setting column bases and bearing plates, clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates. Align column bases and bearing plates for beams and similar structural

members with steel wedges or shims. Tighten anchor bolts after alignment and positioning members and fill entire area under bearing plates with non-shrink, non-metallic grout in accordance with grout section. Do not remove steel wedges or shims but if protruding, cut off flush with edge of base or bearing plate prior to grounding voids solids.

C. Provide anchor bolts and anchors with templates for correct placement into concrete, masonry or other supporting materials.

D. Hold steelwork securely in place with temporary bracing and stays to resist all vertical and lateral loads, until members are permanently fastened and floors and roofs completed. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds. Provide temporary planking or working platforms as necessary to effectively complete the work.

E. Use only calibrated wrenches for tensioning high-strength bolts for slip-critical joints and connections subjected to direct tension.

F. Inspect and torque test field-assembled bolted construction in conformance with AISC Specification for Structural Joints.

G. High-strength tension control bolting may be substituted for calibrated wrench bolting of slip-critical joints and connections subject to direct tension. Do not use high-strength tension control bolts when bolts are galvanized.

H. Set structural frames accurately to lines and elevations indicated. Align and adjust members forming parts of a complete assembly before permanent fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

I. Fasten splices (only where indicated and accepted on shop drawings) of compression members and members having milled ends after the abutting surfaces have been brought completely into contact.

J. Report errors in shop fabrication or deformation resulting from handling or transpiration immediately to Engineer. Replace and remove from job site incorrect fabricated or deformed material at no additional cost to the Owner.

K. Perform temporary bracing and bolting of work to support construction live load and combined dead, wind, earthquake and erection loads as erection progresses. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds. Leave bracing in place as long as necessary to provide safety.

L. Insure that holes are not enlarged and that metal in vicinity of holes is not damaged by drift pins during assembly.

M. Enlarge holes to admit bolts for connections only if approved in writing by the Engineer. Make enlargements only by drilling, avoid burning or hand reaming. Refinish enlarged holes with paint to match the shop coat. Use specific galvanize touch-up for galvanized members.

N. Flame cut bolt holes are not permitted.

O. Where erection bolts are abandoned in place, remove bolts, completely plug weld holes, grind smooth with adjacent surfaces and paint to match shop coat.

3.3 HIGH STRENGTH BOLTING

A. Provide workmanship and techniques for bolted construction in conformance with requirements of AISC/RCSC “Specifications for Structural Joints using High Strength Bolts” and as indicated or specified.

B. Install ASTM F3125 Grade A325 bolts with hardened washer under element being turned in tightening. Install plate washers in both outer plies when using oversize and slotted holes. Install galvanized washer under bolt head and nut when using galvanized bolts.

C. Do not reuse high-strength bolts, nuts and washers.

3.4 WELDING

A. Provide workmanship and techniques for welded construction to conform to requirements of AWS Structural Welding Code and as indicated or specified.

B. No field welding permitted unless indicated on Engineer approved fabrication shop drawings.

C. No field welding permitted on galvanized steel.

3.5 REPAIRS AND PROTECTION

A. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

B. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections. Use specific galvanize touch-up for galvanized members.

END OF SECTION 051200

SECTION 055000 - METAL FABRICATIONS

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 framing and supports for mechanical and electrical equipment.
   2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   3. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section:

   1. Loose steel lintels.
   2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
   3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ladders and alternating tread devices, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Aluminum Ladders: Aluminum ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications 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.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

   1. Prefabricated aluminum ladders and landings.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 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. 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.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

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.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500, cold-formed steel tubing.

C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

D. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: As indicated.
2. Material: Cold-rolled steel, ASTM A 1008/A 1008M, structural steel, Grade 33 (Grade 230); coated with rust-inhibitive, baked-on, acrylic enamel.

2.3 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

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 B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.6 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 will be 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.

1. 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.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated or as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

2.8 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize shelf angles located in exterior walls.

D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.9 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe.

1. Where bollards are indicated to receive controls for door operators, provide necessary cutouts for controls and holes for wire.
2. Where bollards are indicated to receive light fixtures, provide necessary cutouts for fixtures and holes for wire.

B. Prime bollards with zinc-rich primer.

2.10 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 1/12 of clear span but not less than 8 inches (200 mm) unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.11 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.13 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. 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 primers specified in Division 09 painting Section.

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Other Items: SSPC-SP 3, "Power Tool Cleaning."

D. 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.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

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.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.3 INSTALLING METAL BOLLARDS

A. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

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. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking**,** cants, and nailers.
4. Wood furring.
5. Wood sleepers.
6. Plywood backing panels.

B. Related Requirements:

1. Section 017419 “Construction Waste Management Plan” for provision of waste management.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NHLA: National Hardwood Lumber Association.
3. NLGA: National Lumber Grades Authority.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: 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 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 according to ASTM D 5664.
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.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber 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, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded 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.
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 lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent for 2-inch nominal (38-mm actual) thickness or less, no limit for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or 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.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawl spaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying 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 E 84, 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.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction. At a minimum, identify fire

retardant treated wood with the Underwriter's Laboratories label or stamp attesting to the FRS rating or flame spread and smoke index rating, or the ESR Building Code Approval.

E. Application: Treat items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Concealed blocking in fire rated assemblies.
3. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Framing: Construction or No. 2 grade and any of the following species:

1. Hem-fir (north); NLGA.
2. Southern pine; SPIB.
3. Douglas fir-larch; WCLIB or WWPA.
4. Spruce-pine-fir; NLGA.
5. Douglas fir-south; WWPA.
6. Hem-fir; WCLIB or WWPA.
7. Douglas fir-larch (north); NLGA.
8. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

2.5 MISCELLANEOUS LUMBER

A. General: 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.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Eastern softwoods, No. 2 Common grade; NELMA.
4. Northern species, No. 2 Common grade; NLGA.

D. 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.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than [1/2-inch (13-mm)] [3/4-inch (19-mm)] nominal thickness.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.8 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, trim and other items attaced to wall surfaces.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal (38-mm actual) thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

J. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

K. Use steel common 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 between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal-size (19-by-63-mm actual-size) furring at 24 inches (610 mm) o.c.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal-size (19-by-38-mm actual-size) furring vertically at 16 inches (406 mm) o.c.

3.4 SPECIAL COORDINATION

A. Not all items requiring blocking are indicated on drawings. Contractor shall be responsible to review the Drawings and identify all items attached to the walls and ceilings that require blocking for support and attachment. All required blocking shall be included in the Contract Sum.

3.5 PROTECTION

A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

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 includes the following:
   1. Plastic-laminate cabinets.
   2. Plastic-laminate countertops.
   3. Solid-surfacing-material countertops.
   4. Closet and utility shelving.
   5. Shop finishing of interior woodwork.

B. Related Sections include the following:

   1. Section 017419 “Construction Waste Management Plan” for provision of waste management.
   2. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 ACTION SUBMITTALS

A. Product Data: For panel products, high-pressure decorative laminate, solid-surfacing material, cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

   1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   2. Show locations and sizes of cutouts and holes for accessories installed in architectural woodwork.

C. Samples for Initial Selection:

   1. Shop-applied transparent finishes.
   2. Shop-applied opaque finishes.
   3. Plastic laminates.
   4. Solid-surfacing materials.

D. Samples for Verification:

1. Lumber with or for transparent finish, not less than 12 inches x 12 inches, for each species and cut, finished on 1 side and 1 edge.
2. Veneer-faced panel products with or for transparent finish, 12 by 24 inches (300 by 600 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Product Certificates: For each type of product, signed by product manufacturer.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that 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. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork.

C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is 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 woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 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.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: White birch, quarter sawn.

C. Wood Species for Opaque Finish: Any closed-grain hardwood.

D. Wood Products: Comply with the following:

1. Hardboard: AHA A135.4.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD**,** made with binder containing no urea formaldehyde.
3. Softwood Plywood: DOC PS 1**,** Medium Density Overlay.
4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:

a. Abet Laminati, Inc.
b. Arborite; Division of ITW Canada, Inc.
c. Formica Corporation.
d. Lamin-Art, Inc.
e. Nevamar Company, LLC; Decorative Products Div.
f. Westinghouse Electric Corp.; Specialty Products Div.
g. Wilsonart International; Div. of Premark International, Inc.

A. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Avonite, Inc.
b. E. I. du Pont de Nemours and Company.
c. Formica Corporation.
d. Nevamar Company, LLC; Decorative Products Div.
e. Wilsonart International; Div. of Premark International, Inc.

2. Type: Standard type, unless Special Purpose type is indicated.
3. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.2 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.

C. Back-Mounted Pulls: BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 5 inches (100 mm) long, 2 ½" (635 mm) deep and 5/16 inch (8 mm) in diameter.

E. Catches: Magnetic catches, BHMA A156.9, B03141.

F. Shelf Rests: BHMA A156.9, B04013; metal.

G. Drawer Slides: BHMA A156.9, B05091.

1. Standard Duty (Grade 1, Grade 2, and Grade 3): Side mounted and extending under bottom edge of drawer type; full extension type; epoxy-coated steel with polymer rollers.
2. Box Drawer Slides: Grade 1; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.

H. Door Locks: BHMA A156.11, E07121.

I. Grommets for Cable Passage through Countertops: 3 inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Product: Subject to compliance with requirements, provide "XG series" by Doug Mockett & Company, Inc.

J. Counter Support Brackets:

1. Product: Rakks EH Series for flush mounted installation.
2. Provide 5/8" opening grommet to accommodate RJ-45 connectors.
3. Powder coated off-white.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Stainless Steel: BHMA 630.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.3 MISCELLANEOUS MATERIALS

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

B. Adhesives, General: Adhesives shall not contain urea formaldehyde.

C. Adhesive for Bonding Plastic Laminate: Contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.4 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm).

D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

2.5 PLASTIC-LAMINATE CABINETS

A. Grade: Custom.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS.
2. Vertical Surfaces: Grade VGS.
3. Edges: Grade HGS.

D. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.

a. Edges of Plastic-Laminate Shelves: PVC edge banding,0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.

2. Drawer Sides and Backs: Thermoset decorative panels.
3. Drawer Bottoms: Thermoset decorative panels.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Locks: All doors and drawers shall receive locks.

G. 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:

2.6 PLASTIC-LAMINATE COUNTERTOPS

A. Grade: Custom.

B. High-Pressure Decorative Laminate Grade: HGS.

C. 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 manufacturer's full range in the following categories:

D. Edge Treatment: Same as laminate cladding on horizontal surfaces.

E. Core Material: Particleboard or medium-density fiberboard.

F. Core Material at Sinks: Medium-density fiberboard made with exterior glue or exterior-grade plywood.

G. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertop substrate.

H. Paper Backing: Provide paper backing on underside of countertop substrate except at sink locations.

2.7 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Custom.

B. Solid-Surfacing-Material Thickness: As indicated on Drawings.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

   1. As selected by Architect from manufacturer's full range.

D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

   1. Fabricate tops with shop-applied edges of materials and configuration indicated.

E. Install integral sink bowls in countertops in shop.

F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.8 CLOSET AND UTILITY SHELVING

A. Grade: Custom.

B. Shelf Material: 3/4-inch (19-mm) solid lumber or veneer-faced panel product with solid-lumber edge for transparent finish or medium-density fiberboard with solid-lumber edge for opaque finish.

C. Cleats: 3/4-inch (19-mm) solid lumber.

D. Wood Species: Match species indicated for other types of transparent-finished architectural woodwork located in same area of building, unless otherwise indicated] Any closed-grain hardwood for opaque finish.

2.9 SHOP FINISHING

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing architectural woodwork not indicated to be shop finished.

D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

E. Transparent Finish:

1. Grade: Custom.
2. AWI Finish System: Catalyzed vinyl.
3. Staining: Custom stain to match Architect's sample.
4. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.

    a. Apply wash-coat sealer after staining and before filling.

7. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

F. Opaque Finish:

1. Grade: Custom.
2. AWI Finish System: Catalyzed vinyl.
3. Color: As selected by Architect from manufacturer's full range.
4. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Cabinets: Install without distortion so doors and drawers fit openings properly 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.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
3. Secure backsplashes to walls with adhesive.
4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 071113 - BITUMINOUS DAMPPROOFING

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. Cold-applied, emulsified-asphalt dampproofing.

B. Related Requirements:

1. Section 017419 “Construction Waste Management Plan” for provision of waste management.
2. Section 072100 “Thermal Insulation” for perimeter insulation used as protection board.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide auxiliary materials recommended in writing by manufacturer of primary materials.

B. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise required.

2.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

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. APOC, Inc.; a division of Gardner-Gibson.
2. BASF Construction Chemicals - Building Systems; Sonneborn Brand Products.
3. Brewer Company (The).
4. ChemMasters, Inc.
5. Euclid Chemical Company (The); an RPM company.
6. Gardner-Gibson, Inc.
7. Henry Company.
8. Karnak Corporation.
9. Koppers Inc.
10. Malarkey Roofing Products.
11. Meadows, W. R., Inc.

B. Trowel Coats: ASTM D 1227, Type II, Class 1.

C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.

D. VOC Content: Zero.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.

D. Patching Compound: Asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.

E. Protection Course: ASTM D 6506, 1/8-inch- (3-mm-) thick, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.

F. Protection Course: Extruded-polystyrene board insulation, as specified in Section 072100 for foundation insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.

B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.

C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.

1. Apply dampproofing to provide continuous plane of protection.
2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.

1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

C. All structural steel and miscellaneous ungalvanized ferrous metals in contact with concrete shall be dampproofed with one brush coat to a minimum coverage per manufacturer’s recommendations.

D. All below grade foundation walls, with occupiable spaces on interior side and elevator pit walls shall be dmapproofed.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Concrete Foundations: Apply one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m) or one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m) and as recommended by manufacturer.

3.5 INSTALLATION OF PROTECTION COURSE

A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

1. Support protection course over cured coating with spot application of adhesive type recommended in writing by protection-board manufacturer.
2. Install protection course on same day of installation of dampproofing (while coating is tacky) to ensure adhesion.

3.6 CLEANING

A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071113

SECTION 072100 - THERMAL INSULATION

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. Extruded polystyrene foam-plastic board.
2. Glass fiber blanket
3. Mineral-wool blanket.
4. Mineral-wool board.
5. Vapor retarders.

B. Related Requirements:

1. Section 017419 “Construction Waste Management Plan” for provision of waste management.
2. Section 071113 “Bituminous Dampproofing” for rigid insulation used as protection of dampproofing.
3. Section 075423 “TPO Roof System" for insulation specified as part of roofing construction.
4. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. 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.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

1. 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. Diversi Foam Products
   b. Dow Chemical Company
   c. Owens Corning

2.2 GLASS-FIBER BLANKET

A. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

B. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.3 VAPOR RETARDERS

A. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than 22 lb/1000 sq. ft. (10 kg/100 sq. m), with maximum permeance rating of 0.1317 perm (7.56 ng/Pa x s x sq. m) and with flame-spread and smoke-developed indexes of not more than 25 and 450, respectively, per ASTM E 84.

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. Raven Industries Inc.; DURA-SKRIM 2FR.
   b. Reef Industries, Inc.; Griffolyn T-55 FR.

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

D. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.

2.4 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Angle: Formed from 0.030-inch- (0.762-mm-) thick, perforated, galvanized carbon-steel sheet with each leg 2 inches (50 mm) square.
2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.

D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.5 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

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 FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to 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.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. 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

SECTION 07 26 19 – TOPICAL MOISTURE VAPOR MITIGATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, general provisions of the Contract, and other related construction documents such as Division 01, Division 03, and Division 09 specifications that apply to this Section.

1.2 SUMMARY

A. This Section includes a single-coat, fast-curing, 100% solids epoxy resin moisture management system formulated to suppress excessive moisture vapor emissions in existing concrete slab on grade conditions prior to installing new flooring products the below referenced topical moisture vapor mitigation system.

B. Related Sections include the following:

1. Section 09 65 00, Resilient Flooring

1.3 REFERENCES

A. ASTM F2170 - Relative Humidity in Concrete Floor Slabs Using in situ Probes

B. ASTM F1869 - Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

C. ASTM 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

D. ASTM C1583 - Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension

E. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials

F. ASTM D1308 - Chemical Resistance of Finishes.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used. Include manufacturer's Material Safety Data Sheets.

B. Qualification Data: For Installer

1.5 QUALITY ASSURANCE

A. Installation of the topical moisture vapor mitigation system products must be completed by a certified applicator, using mixing equipment and tools approved by the manufacturer.

B. Manufacturer Experience: Provide products of this section by companies which have successfully specialized in production of this type of work for not less than 5 years. Contact Manufacturer Representative prior to installation.

1.6 WARRANTY

A. Certified applicator must file a pre-installation checklist with the flooring manufacturers and receive written confirmation of the approval to proceed in order to obtain Warranty.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver products in original packaging, labeled with product identification, manufacturer, batch number and shelf life.

B. Store products in a dry area with temperature maintained between 50° and 85° F (10° and 29° C) and Protect from direct sunlight.

C. Handle products in accordance with manufacturer's printed recommendations.

1.8 PROJECT CONDITIONS

A. Do not install material below 50° F (10° C) surface and air temperatures. These temperatures must also be maintained during and for 48 hours after the installation of products included in this section. Install quickly if substrate is warm and follow warm weather instructions available from the manufacturer.

PART 2 - PRODUCTS

2.1 TOPICAL MOISTURE VAPOR EMMISION SYSTEM (MVM)

A. Manufacturer: Basis of Design: CMP, LOCKDOWN, two component, 100% solids, Vapor Suppression System Standalone Coating, Broadcast Primer and Crack Repair. Comparable products by alternate manufacturers are acceptable subject to compliance with the quality and performance requirements established by the specified product..

1. Product Specifics:

a. Vapor Reduction: 100% RH per ASTM F2170 and unlimited MVER: 300 Square Feet per 2.5 gallon kit minimum film thickness: 14 mils

b. Application Temperature Range: 40 – 90 Degree Fahrenheit

c. Pot Life: 25 – 30 minutes

d. Ready Time: (70 Degree Fahrenheit 50% RH) Receive CMP's leveling compounds: After 12 hours up to 36 hours. Adhesive rated for non-porous substrates: 16 hours

e. ASTM E96 (Permeability): <0.06 perms

f. Volitale Organic Compounds: 0 g/L (calculated & reported, SCAQMD 1113)

PART 3 – EXECUTION

3.1 PREPARATION

A. Concrete Subfloors: Prepare substrate in accordance with manufacturer's instructions.

1. Prior to proceeding please refer to ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring. All concrete subfloors must be sound, solid, clean, and free of all oil, grease, dirt, curing compounds and any substance that might act as a bond breaker before application.

2. Mechanical preparation of the surface is required to obtain a minimum ICRI concrete surface profile of 3 (CSP 3). This substrate preparation must be by mechanical means, such as shot blasting. Thoroughly sweep or vacuum to remove all loose materials. The resulting concrete surface must be deemed clean, sound and solid prior to proceeding with the installation.

3. The concrete must have a minimum tensile strength of at least 150 psi for areas to receive normal foot traffic, and 200 psi for area of heavy commercial traffic when tested in accordance with ASTM C1583. The concrete surface can be damp, but must be free of standing water.

4. Prior to beginning the installation, measure the relative humidity within the concrete (ASTM F2170). Alternatively, you can also measure the surface relative humidity in accordance with ASTM F2420. For these relative humidity methods, the RH shall not exceed 100%.

   a. Test several areas for moisture emission using the relative humidity test method in accordance with ASTM F2170 in accordance with the manufacturer's written recommendations.

   b. If the results are greater than the flooring manufacturer's recommendation, then the specified product cant be used.

B. Joint Preparation

1. Moving Joints – honor all expansion and isolation joints up through the moisture mitigation system and underlayment.

2. Saw Cuts and Control Joints – fill all non-moving joints with joint filler, as recommended by the manufacturer.

3.2 MOISTURE REMEDIATION INSTALLATION

A. Examine substrates and conditions under which materials will be installed. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Coordinate installation with adjacent work to ensure proper sequence of construction. Protect adjacent areas from contact due to mixing and handling of materials.

C. Mixing: Comply with manufacturer's printed instructions.

D. Application: Comply with manufacturer's printed instructions.

3.3 FIELD QUALITY CONTROL

A. Comply with manufacturer's printed instructions.

3.4 PROTECTION

A. Prior to the installation of the finish flooring, the surface of the underlayment should be protected from abuse by other trades by the use of plywood, Masonite or other suitable protection course.

END OF SECTION 07 26 19

SECTION 072726 - FLUID-APPLIED MEMBRANE 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 fluid-applied, vapor-permeable membrane air barriers.

B. Related Requirements:

1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.

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 the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

1.8 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.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended 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, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-permeable 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, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E2178.

2.3 VAPOR-PERMEABLE MEMBRANE AIR-BARRIER

A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane.

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. Henry Company; Air-Bloc 17MR or Air-Bloc33MR.
b. Meadows, W. R., Inc.; Air-Shield LMP.
c. Grace, W. R., & Co. - Conn.; Perm-A-Barrier VP.

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
b. Vapor Permeance: Minimum 10 perms (580 ng/Pa x s x sq. m); ASTM E 96/E 96M.
c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.

2.4 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.

C. Counterflashing Strip: Modified bituminous, 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 32 mils (0.8 mm) of rubberized asphalt laminated to an 8-mil- (0.2-mm-) thick, cross-laminated polyethylene film with release liner backing.

D. Butyl Strip: Vapor retarding, 30 to 40 mils (0.76 to 1.0 mm) thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.

E. Modified Bituminous Strip: Vapor retarding, 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.

F. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.

G. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

H. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

I. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, **0.0187 inch (0.5 mm)** thick, and Series 300 stainless-steel fasteners.

J. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft (24- to 32-kg/cu. m) density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

K. Modified Bituminous Transition Strip: Vapor retarding, 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.

L. Adhesive-Coated Transition Strip: Vapor-permeable, 17-mil- (0.43-mm-) thick, self-adhering strip consisting of an adhesive coating over a permeable laminate with a permeance value of 37 perms (2145 ng/Pa x s x sq. m).

M. Elastomeric Flashing Sheet: ASTM D 2000, minimum 50- to 65-mil- (1.3- to 1.6-mm-) thick, cured sheet neoprene with manufacturer-recommended contact adhesives and lap sealant with aluminum termination bars and stainless-steel fasteners.

N. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

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; 123 Silicone Seal.
b. Momentive Performance Materials Inc.; US11000 UltraSpan.
c. Pecora Corporation; Sil-Span.
d. Tremco Incorporated, an RPM company; Spectrem Simple Seal.

O. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants."

P. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

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 concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
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, and seal substrate according to manufacturer's written instructions. 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. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. 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.

G. 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.

3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches (75 mm) along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.

B. Gypsum Sheathing: Fill joints greater than 1/4 inch (6 mm) with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install butyl or modified bituminous strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. 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.

F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip as recommended by the air barrier manufacturer so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames with not less than 1 inch (25 mm) of full contact.

1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.
2. Adhesive-Coated Transition Strip: Roll firmly to enhance adhesion.
3. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches (150 mm) o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
4. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, modified bituminous strip.

J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.

1. Apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties or architectural precast concrete anchors.

1. Vapor-Permeable Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil (1.0-mm) dry film thickness, applied in one or more equal coats.

C. Apply strip and transition strip a minimum of 1 inch (25 mm) onto cured air-barrier material according to air-barrier manufacturer's written instructions.

D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests: As determined by Owner's testing agency from among the following tests:

1. Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E779 as required by the Rhode Island State Energy Conservation Code (SBC-8). The leakage rate of the building envelope shall not exceed 0.40 cfm/sq. ft. at a pressure differential of 0.3 inches water gauge (2.0L/sq. m @ 75Pa) or an acceptable method acceptable to the local code official.
2. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. (207 kPa) according to ASTM D 4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 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 required by manufacturer. If exposed to these conditions for more than [**30**] [**60**] <**Insert number**> days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane 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 by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 07 54 23 - THERMOPLASTIC POLYOLEFIN (TPO) 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. Self-Adhered TPO membrane roofing system.
2. Vapor barrier membrane.
3. Roof insulation.
4. Protection / cover boards

B. Related Sections:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counter-flashings.
3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. TPO: Thermoplastic polyolefin.

B. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7. The risk factor for this project is 3 / 4, The wind zone for this project 139 mph.

D. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacing's and patterns for mechanically fastened membrane roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:

1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
2. Roof insulation.
3. Walkway pads or rolls.

D. Qualification Data: For qualified Installer and manufacturer.

E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of compliance with performance requirements.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

G. Field quality-control reports.

H. Maintenance Data: For roofing system to include in maintenance manuals.

I. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is FM Approvals approved for membrane roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

C. Source Limitations: Obtain components including roof insulation, fasteners, adhesives for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer].

D. Exterior Fire-Test Exposure: ASTM E 108, Class A for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.7 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.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

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.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes edge metal, membrane roofing, base flashings, roof insulation, fasteners, cover boards, vapor retarders, and other components of membrane roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.
3. Wind speed warranty shall be for 90 mph by the roofing manufacturer as measured 12 meters above grade

PART 2 - PRODUCTS

2.1 TPO MEMBRANE ROOFING

A. Fabric-Reinforced Self-Adhered Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet.

a. Firestone Building Products Company – UltraPly TPO SA.
b. Carlisle SynTec Incorporated.
c. Approved Equal.

2. Thickness: 60 mils, nominal.
3. Exposed Face Color: White.

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Plastic Foam Adhesives: 50 g/L.
b. Insulation and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Contact Adhesive: 80 g/L.
f. Other Adhesives: 250 g/L.
g. Single-Ply Roof Membrane Sealants: 450 g/L.
h. Nonmembrane Roof Sealants: 300 g/L.
i. Sealant Primers for Nonporous Substrates: 250 g/L.
j. Sealant Primers for Porous Substrates: 775 g/L.

B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as sheet membrane.

C. Bonding Adhesive: Manufacturer's low VOC adhesive where necessary.

D. 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.

E. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), pre-punched.

F. Fasteners: Factory-coated steel heavy duty fasteners and metal plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening reinforced perimeter fastening (RPF) strip to substrate, and acceptable to membrane roofing system manufacturer.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.3 PROTECTION OR COVER BOARD

A. Protection or Cover Board: ASTM C 1289, Type II, Class 4, Grade 2, high density, closed-cell, polyisocyanurate foam and coated glass facers, 1/2 inch thick (12.7 mm) with a compressive strength of 80 PSI, and a LTTR R-Value of 2.5.

1. Products: Subject to compliance with requirements, provide the following include, but are not limited to, the following:

a. Firestone Building Products; ISOGARD HD Cover Board or an approved or equal.

B. Foam Adhesive: Two-component low-rise polyurethane adhesive solvent free and VOC free insulation adhesive (I.S.O. Twin Pack Adhesive as manufactured by Firestone Building Products or equal) for installing insulation to concrete decks and cover boards to polyisocyanurate at designated areas.

2.4 VAPOR BARRIER MEMBRANE

A. Self-Adhered Vapor Barrier: ASTM E 2178 and ASTM D 1970, 30 mils SBS modified bitumen adhesive, factory laminated to a tri-laminated woven, high density polyethylene top surface, class I vapor retarder (perm rating = .02) “V-Force” vapor barrier membrane as manufactured by Firestone Building Products or equal.

1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
2. All joints and terminations must be sealed with manufacturers tape.

2.5 ROOF INSULATION resistance per ASTM D3273.

1. Density shall be 20 psi.

2. Provide 4.0” minimum tapered thickness at low points on designated roof areas that have existing insulation totally removed down to existing roof deck substrate as is indicated on the drawings.

B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) with a 1” minimum thickness at low points at locations indicated on drawings or unless otherwise indicated on the drawings.

C. Provide preformed polyisocyanurate saddles, crickets, tapered edge strips, and other insulation shapes were indicated for sloping to drain. Fabricate to 1/2 inch per 12 inches (1:24) slopes unless otherwise indicated on the drawings.

2.6 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. Foam Adhesive: Two-component low-rise polyurethane adhesive solvent free and VOC free insulation adhesive (I.S.O. Twin Pack Adhesive as manufactured by Firestone Building Products or equal) for installing insulation to concrete decks and cover boards to polyisocyanurate at designated areas.

2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads], approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and curbs are set and braced and that 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 surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. At designated areas remove existing roof system down to existing roof system substrates located on concrete plank as indicated on the roof system types on the drawings.

B. Clean substrate of gravel, dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

C. 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.

D. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 VAPOR BARRIER MEMBRANE INSTALLATION

A. Self-Adhering-Sheet Vapor Barrier Membrane: Prime substrate. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches (90 mm) and 6 inches (150 mm), respectively. Seal laps by rolling.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.4 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 3.0 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

H. Install protection 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. Adhere protection boards according to requirements of ASCE-7 requirements and 25 year/90 MPH warranty.

2. REMOVE Attachment over steel decks shall require no less than 16 fasteners in the field, 24 fasteners at perimeter: and 32 fasteners per 4 foot by eight foot boards at all corner locations.

3. All perimeter edge securement of membrane with RPS strip shall be 9” o.c. with heavy duty fasteners.

3.5 PROTECTION BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Loosely butt substrate boards together.

1. REMOVE Fasten protection board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
2. Adhere protection board to top layer of insulation to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' requirement to meet uplift pressures.

3.6 SELF-ADHERED MEMBRANE ROOFING INSTALLATION

A. Self-adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. In addition to self-adhering, mechanically fasten membrane roofing securely at terminations, penetrations, corners and perimeter of roofing.

E. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

F. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

G. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

3.7 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane 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.

3.8 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements. Contractor shall provide job in progress (JIP) reports by the roofing manufacturer to the Architect.

3.10 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing 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 membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <Insert name of installer> of <insert address of installer>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <Insert name of Owner>.
2. Address: <Insert address>.
3. Building Name/Type: <Insert information>.
4. Address: <Insert address>.
5. Area of Work: <Insert information>.
6. Acceptance Date: <Insert date>.
7. Warranty Period: <Insert time>.

8. Expiration Date: <Insert date>.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

   a. Lightning;
   b. Peak gust wind speed exceeding 90 mph (m/sec);
   c. Fire;
   d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. Vapor condensation on bottom of roofing; and
   g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.

1. Authorized Signature: <Insert signature>.
2. Name: <Insert name>.
3. Title: <Insert title>.

END OF 07 54 23

SECTION 076200 - SHEET METAL FLASHING AND TRIM

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. Manufactured reglets with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications.
4. Formed wall sheet metal fabrications.
5. Formed equipment support flashing.

B. Related Requirements:

1. Section 034100 Pre-cast Structural Concrete Wall Panels for installation of sheet metal flashing and trim integral with roofing.Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 075423 "TPO Roof System" fo216r installation of sheet metal flashing and trim integral with roofing.
3. Section 074213 "Metal Composite Material Wall Panels" for sheet metal flashing and trim integral with metal wall panels.
4. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, vents, and other manufactured roof accessory units.

1.3 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.

1.4 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 each manufactured product and accessory.

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 expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.

C. Samples for Verification: For each type of exposed finish indicated with factory applied finishes to match color as specified in other Sections.

1. Sheet Metal Flashing: 12 inches (300 mm) long.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample x 12” long sections of gutter and downspout.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that 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 fabrication and installation.

1. Build mockup of typical roof edge, including gutter and downspouts at wall mockup designated on the Drawings, including supporting construction cleats, seams, attachments, underlayment, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 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. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

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.

1.9 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. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. 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 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. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

D. 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).

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 B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with embossed surface.

1. As-Milled Finish: Standard two-side bright.

2. Exposed Coil-Coated Finish:
   a. Metallic Fluoropolymer: AAMA 620. Three-coat fluoropolymer finish with suspended metallic flakes 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.

3. Color: To match selected color of exterior wall panels as specified in Section 074213 “Metal Composite Materials Wall Panels”.
4. 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. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.

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. Atlas Roofing Corporation; Summit.
   b. Engineered Coated Products; Nova-Seal II.
   c. Kirsch Building Products, LLC; Sharkskin Comp or Sharkskin Ultra.
   d. SDP Advanced Polymer Products Inc; Palisade.

C. Self-Adhering, High-Temperature Sheet: 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 according to written recommendations of underlayment manufacturer.

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. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT.
   b. Henry Company; Blueskin PE200 HT.
   c. Kirsch Building Products, LLC; Sharkskin Ultra SA.
   d. Metal-Fab Manufacturing, LLC; MetShield.
   e. Owens Corning; WeatherLock Specialty Tile & Metal Underlayment.
   f. Polyguard Products, Inc.; Deck Guard HT.
   g. Protecto Wrap Company; Protecto Jiffy Seal Ice & Water Guard HT.
   h. SDP Advanced Polymer Products Inc; Palisade SA-HT.

2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.4 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 or manufactured item 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 and recommended by manufacturer of primary sheet metal or manufactured item.

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.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

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 C 920, elastomeric polyurethane or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.

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. Cheney Flashing Company.
b. Fry Reglet Corporation.

c. Heckmann Building Products, Inc.
d. Hickman, W. P. Company.
e. Hohmann & Barnard, Inc.
f. Keystone Flashing Company, Inc.
g. National Sheet Metal Systems, Inc.
h. Sandell Manufacturing.

2. Material: Stainless steel, 0.019 inch (0.48 mm) thick or Aluminum, 0.024 inch (0.61 mm) thick.
3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
5. Accessories:

   a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
   b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

6. Finish: Mill.

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. 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.
2. Obtain field measurements for accurate fit before shop fabrication.
3. 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.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: 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.

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, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

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 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.

2.7 GUTTERS AND DOWNSPOUTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide preformed gutters and downspouts shall be as manufactured Southern Aluinum Finishing Company, 8370 East Highway 78, Villa Rica, GA. Tel: 800-334-9823. Comparable products by alternate manufacturers are acceptable subject to compliance with the quality and performance standards established by the specified Product.

B. Gutters: Perimeter Systems' Designer Series Commercial Gutter System "Batten Profile", 6" size, Model Number DSB-6

1. Concealed Gutter Liner shall be manufactured from 0.050" mill finished aluminum in 10'-0" lengths. Liner shall be:

    a. Factory notched to receive brackets and straps.
    b. Manufactured with 1" telescoping and notched end laps.
    c. Factory punched with fastening holes elongated to allow for thermal movement.

2. Support Bracket shall be manufactured from 0.125" x 1.00" aluminum, heliarc welded construction, factory punched for fasteners.
3. Interior Straps shall be manufactured from 0.125" x 1.00" aluminum.
4. Batten Profile, Snap-On fascia, shall be manufactured from 0.040" aluminum, 10'-0" lengths. Fascias shall be press formed with radius dies on a CNC Press to provide repeated true and accurate profiles.
5. Fascia Splices shall be manufactured from 0.040" aluminum, 6" lengths, formed to fit the inside of the snap-on fascia.
6. Accessories:
    a. Mitered Corners: Provide factory mitered corners for both fascia and liner. Fascia profiles shall be precision saw cut, heliarc tack welded to produce a picture frame joint. Concealed liner miter shall be precision saw cut with a continuous heliarc weld watertight joint.
    b. Sculptured End Caps: Provide factory mitered end caps for fascias. Fascia profiles shall be precision saw cut, heliarc tack welded to produce a picture frame joint.
    c. Liner End Caps: Provide mill finished aluminum liner end caps at all Fascia End Caps and wall abutments.
    d. Liner Expansion Joint: Provide manufacturer's elastomeric expansion joints at 40' intervals or as shown on shop drawings.
    e. Sealant: Shall be polyurethane or silicon based water-proofing type, compatible with aluminum gutter, downspout, and abutting dissimilar materials for intended application.

C. Downspouts: Provide downspout Model Number DS-EX, 0.125” thickness, in sizes and locations as indicated on plans. Downspouts shall be manufactured from extruded aluminum, alloy 6063-T5 finished to match gutter fascia mouldings. Downspout elbows shall have heliarc welded joints.

1. Size: 3” x 6”.

2. Wall Bracket: Provide Style 1 Wall brackets at 60" maximum spacing (minimum 2 brackets). Brackets shall be manufactured from 0.125" x 1.00" aluminum, finished to match downspout.
3. Elbows: Type D/E with heliarc welded joints.
4. Outlets: At all downspout locations provide aluminum outlets to connect liner to downspout.

D. Finish:

1. General: Apply coatings to exposed aluminum components after fabrication for maximum coating performance and to prevent crazing, abrasion, and damage to finished surfaces.

2. Pretreatment: Aluminum components shall be pretreated with solutions to remove organic and inorganic surface soils, remove residual oxides, followed by a chrome phosphate conversion coating to which organic coatings will firmly adhered.
3. Coating Type: High Performance Coating, two-coat, shop applied, 70% Polyvinylidene Fluoride (PVDF) coating based on Elf Arkema Chemicals, Inc. Kynar 500 or Ausimont U.S.A., Inc. Hylar 5000 resin, meeting AAMA 2605 specification.
4. Color: To match color as specified in other Sections.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, exposed cover plate.
2. Fabricate from the Following Materials:
   a. Aluminum: 0.050 inch (1.27 mm) thick.
3. All roof edge flashing shall receive exposed coil-coated finish.

B. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.040 inch (1.02 mm) thick.

C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.

D. Flashing Receivers: Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.

E. Roof-Penetration Flashing: Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

2.9 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.

2.10 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

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 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. 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. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

D. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. 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 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. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate 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. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Rivets: Rivet joints in uncoated aluminum or zinc where necessary for strength.

3.4 GUTTER AND DOWNSPOUT INSTALLATION

A. General: Install gutters and downspouts to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Examination:

1. The installer must examine substrates and conditions under which commercial gutter system will be installed. All wood plates and/or fascia boards shall be installed true, straight, and free of splits, cracks, or other irregularities. Do not proceed with installation until unsatisfactory conditions are corrected.

C. Preparation:

1. Prior to the installation of the commercial gutter system, soffits, extenders, and associated cornice profiles shall be installed.
2. Installer shall thoroughly read and follow manufacturer's installation instructions before proceeding with installation.

D. Installation:

1. General: The commercial gutter system shall be installed in strict accordance with manufacturer's printed instructions. Deviations from the instructions are not allowed.
2. Support Brackets: Layout support brackets to provide 1/2" slope in 40 linear feet. Install support brackets with #10 x 2" stainless steel wood screws.
3. Liner: Install concealed gutter liner onto support brackets and fasten to substrates with 1-1/2" aluminum or stainless steel nails. Rivet and seal liner joints with high grade exterior sealant as recommended by gutter manufacturer.
4. Expansion Joints: Install elastomeric expansion joints as shown on plans and/or shop drawings. Maximum expansion joint spacing shall be 40' centers.
5. Locate and install downspouts before proceeding with fascia installation.
6. Install Fascia with concealed splice plates over support brackets and liner. Coordinate and align spacing of joints with associated trims if applicable. Plan spacing of joints so there are no sections of fascia shorter than 48" in length. Check horizontal alignment of fascia during installation and adjust as required. At downspout locations, neatly cut fascia to accommodate downspout.
7. Install interior straps by fully engaging them into liner and fascia, complete by securely riveting.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements**,** sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm). Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant or interlocking folded seam or blind rivets and sealant unless otherwise indicated.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.7 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.8 ERECTION 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.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.9 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. 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.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

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. Roof hatch.
2. Roof hatch safety railing system.

B. Related Sections:

1. Section 017419 “Construction Waste Management Plan” for provision of waste management.

1.3 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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.6 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.

1.7 WARRANTY

A. Warranty: Manufacturer's standard warranty indicating that materials shall be free of defects in material and workmanship for the time period indicated below from the date of Substantial Completion. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

1. Roof Hatch: Five years.
2. Safety Railing System: Five years.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: As manufactured.

B. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, thickness as indicated.

C. Wood Nailers: As specified in Section 061053 Miscellaneous Rough Carpentry.

D. Underlayment:

1. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

E. 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 Aluminum Sheet: Aluminum or Series 300 stainless steel.

F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.3 ROOF ACCESSORIES

A. Basis-of-Design Products: Roof accessories specified below shall be as manufactured by The Bilco Company, New Haven, CT; Tel: 800-366-6530. Comparable products by alternate manufacturers are acceptable subject to compliance with the quality and performance standards established by the specified Product.

2.4 ROOF HATCH

A. Curb: Shall be 12” (305mm) in height and of 11 gauge (2.3mm) aluminum. The curb shall be formed with a 4-1/2” (114mm) flange with 7/16” (11mm) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6” (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.

B. Curb insulation: Shall be 3” (76mm) thick polyisocyanurate with an R-value = 20.3.

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. General: Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, 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.

1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof-Hatch Re-Installation:

1. Install roof hatch so top surface of hatch curb is level.
2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.

3. Re-Attach safety railing system to roof-hatch curb or as occurs. Test for proper function and adjust as required until proper operation is achieved.

3.3 REPAIR, REPLACE AND CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions.

B. Clean off excess sealants.

C. Replace roof hatch assembly and roof accessories that have been damaged or that cannot be successfully reinstalled. Replace roof accessories that cannot be repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

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. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies – rated and non-rated.

B. Related Requirements:

1. Section 017419 “Construction Waste Management Plan” for provision of waste management.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Simultaneous with the submission of the firestop system submittals, the Contractor shall schedule a pre-installation conference with the firestopping system contractor and manufacturer’s technical representative. At a minimum, the conference shall be attended by the on-site foreman of each trade whose work requires firestop systems. The purpose of the meeting shall be to answer questions, review application procedures and review the requirements for annular spaces, sleeves, etc. to insure that they are properly installed in the walls and floors in accordance with manufacturer’s tested systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
3. A copy of the approved schedule and manufacturer’s drawings shall be maintained in the field as a guide for installation.

4. For penetrations involving insulated piping, provide firestopping system that includes insulation passing through the penetration.

C. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

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. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system 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 materials per 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 installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by inspecting agency, Architect, Contractor and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. Non-rated Horizontal Assembly: At least one hour.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 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.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

F. Accessories: 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.

1. Permanent forming/damming/backing materials.

2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. 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.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 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 immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials 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 where recommended in writing by manufacturer 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 to comply 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.

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

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 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

SECTION 079200 - JOINT SEALANTS

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. Urethane joint sealants.
2. Latex joint sealants.

B. Related Requirements:

1. Section 017419 “Construction Waste Management Plan” for provision of waste management.
2. Section 092900 "Gypsum Board" for sealing joints in sound-rated construction.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial 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. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

B. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. 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.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: 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: Two years from date of Substantial Completion.

B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from 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 JOINT SEALANTS, 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. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following:

1. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, 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. BASF Building Systems; Sonolastic NP1, Sonolastic TX1, Sonolastic Ultra.
   b. Pecora Corporation; Dynatrol I-XL.
   c. Polymeric Systems, Inc.; Flexiprene 1000.
   d. Sika Corporation, Construction Products Division; Sikaflex-1a.
   e. Tremco Incorporated; Dymonic, Vulkem 116.

B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and 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. BASF Building Systems; Sonolastic SL.
   b. Pecora Corporation; Urexpan NR-201.
   c. Polymeric Systems, Inc.; Flexiprene 952.
   d. Sika Corporation, Construction Products Division; Sikaflex-1CSL.
   e. Tremco Incorporated; Vulkem 45.

2.3 LATEX JOINT SEALANTS

A. Acrylic Latex: 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. BASF Building Systems; Sonolac.
   b. Bostik, Inc.; Chem-Calk 600.
   c. Pecora Corporation; AC-20+.
   d. Tremco Incorporated; Tremflex 834.

2.4 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

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 performance of the Work.

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 but are not limited to the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

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 but are not limited to the following:

    a. Metal.
    b. Glass.
    c. 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.
4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.

    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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Control and expansion joints in brick pavers.
b. Isolation and contraction joints in cast-in-place concrete slabs.
c. Joints between plant-precast architectural concrete paving units.
d. Joints in stone paving units.
e. Joints between different materials listed above.
f. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, P, 25, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints in concrete unit masonry.
b. Joints in precast concrete panels.
c. Joints between metal panels.
d. Joints between different materials listed above.
e. Perimeter joints between materials listed above and frames of doors, windows, louvers and other penetrations.
f. Control and expansion joints in ceilings and other overhead surfaces.
g. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

a. Control joints on exposed interior surfaces of exterior walls.
b. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
c. Perimeter joints of plumbing fixtures at walls, floor and counters

d. Perimeter joints of countertops, backsplashes and other horizontal surfaces where they abut adjacent walls
e. Where dissimilar materials abut unless noted otherwise.
f. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL 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 hollow-metal work.

B. Related Requirements:

1. Section 017419 “Construction Waste Management Plan” for provision of waste management.
2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
3. Division 26 “Electrical” Sections for electrical connections including conduit and wiring for door controls and operators installed on hollow metal doors and frames.
4. Division 28 Access Control for access control devices installed at hollow metal doors and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 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.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each frame and vision panel 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 anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.

8. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work 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 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amweld International, LLC.
2. Ceco Door Products; an Assa Abloy Group company.
3. Curries Company; an Assa Abloy Group company.
4. Pioneer Industries, Inc.
5. Republic Doors and Frames.
6. Steelcraft; an Ingersoll-Rand company.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: At fire rated door and frame assemblies opening to a corridor or located within a smoke barrier, provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to

authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR VISION PANELS AND FRAMES

A. Construct interior doors, vision panels and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Frames: SDI A250.8, Level 2. At all interior door locations unless noted otherwise on the Drawings.

1. Physical Performance: Level B according to SDI A250.4.

2. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Frames: SDI A250.8, Level 3. At all exterior doors unless noted otherwise.

1. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
b. Construction: Full profile welded.

2. Exposed Finish: Prime.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. 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.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelight 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 butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
        1) Two anchors per jamb up to 60 inches (1524 mm) high.
        2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
        3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
        4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

    b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

        1) Three anchors per jamb up to 60 inches (1524 mm) high.
        2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
        3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
        4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.

    c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
6. 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.

C. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

E. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow-metal work.
5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 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.

2.9 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

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 the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame 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. 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.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-rated openings, install frames according to NFPA 80.

b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable stops located on secure side of opening.
d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

   a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
6. 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.
7. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb 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.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. 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.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finishing according to manufacturer's written instructions.

F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

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-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames".
2. Section 081216 "Interior Aluminum Frames" for wood doors in interior aluminum frames.
3. Section 087100 “Door Hardware”.
4. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction**,** louvers, and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish**.** For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Louver blade and frame sections, 6 inches (150 mm) long, for each material and finish specified.
3. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in in manufacturer’s standard plastic bags, stretch wrap or cardboard cartons.

C. Mark each door on top rail with opening number used on Shop Drawings. Include manufacturer’s order number and date of manufacture.

1.6 FIELD CONDITIONS

A. Environmental Limitations: 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 ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

B. Environmental Limitations: 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 between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

1.7 WARRANTY

A. 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.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Signature Series flush wood veneer doors as manufactured by Marshfield Door Systems, Inc or a comparable product by one of the following:

1. Algoma Hardwoods, Inc.
2. Eggers Industries.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
3. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
4. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

D. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

E. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde.
2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.

F. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.

3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

a. Screw-Holding Capability: 550 lbf (2440 N) per WDMA T.M.-10.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade A faces.
2. Species: Select white birch.

3. Cut: Rotary cut.
4. Match between Veneer Leaves: Book match.
5. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
6. Exposed Vertical Edges: Applied wood-veneer edges of same species as faces and covering edges of faces - edge Type B.
7. Core:
   a. Non-Rated Doors: Particleboard.
   b. Rated Doors: Mineral Core.
8. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
9. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads, profile per Marshfield W-6.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

C. Metal Louvers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Air Louvers, Inc.
   b. Anemostat; a Mestek company.

2. Blade Type: Vision-proof, inverted Y.
3. Metal and Finish: Manufacturer’s standard 18 gauge cold-rolled steel with baked-enamel- or powder-coated finish.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

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."
3. Louvers: Factory install louvers in prepared openings.

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: WDMA TR-6 catalyzed polyurethane.
3. Staining: Manufacturer’s Sand 22-95.
4. Effect: Filled finish.
5. Sheen: Satin.

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. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

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 084113 – ALUMINUM INTERIOR FRAMES AND ENTRANCES

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 non-thermally broken storefront framing.
2. Interior manual-swing non-thermally broken entrance doors for installation in interior storefront framing.

B. Related Requirements:
1. Section 087100 “Door Hardware” for door hardware specified for aluminum doors.
2. Section 088000 “Glazing” for insulating and non-insulating glass.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

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.

B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance.

C. Product Test Reports: For aluminum-framed entrances, for tests performed by a qualified testing agency.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY

A. Special Warranty: Manufacturer and Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal and structural movements.
c. Deterioration of metals and other materials beyond normal weathering.
d. Failure of operating components.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes 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 D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS, GENERAL

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

2.2 PERFORMANCE STANDARDS

A. Structural Loads :
1. Design Loads: In accordance with the Rhode Island State Building Code (SBC - 2021) and as indicated on Drawings.

B. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

C. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.

D. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.3 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide aluminum entrances and interior storefronts as manufactured by Kawneer or comparable product by one of the following:

1. EFCO Corporation.
2. Oldcastle Building Envelope.

B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.4 FRAMING

A. Framing Members: Manufacturer's standard interior non-thermally broken framing system – Kawneer Tri-Fab VG 451.

1. Frame Size: 2” x 4 ½”.
2. Glazing Plane: Center.
3. Reinforce framing as required to achieve storefront framing configuration shown on the Drawings.

B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum framing members, trim hardware, anchors, and other components.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.

2.5 ENTRANCE DOOR SYSTEMS

A. Non-thermally Broken Entrance Doors: Manufacturer’s non-thermally broken entrance doors for manual swing operation – Kawneer Series 190 Narrow Stile Door.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members with 2 1/8 inch vertical stiles, top rail at 2 ¼ inch and 3 7/8 inch bottom rail.

2. Door Design: As indicated on Drawings.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

    a. Provide nonremovable glazing stops on outside of door.

2.6 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

2.7 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads**,** finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.9 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Storefront Framing: Fabricate components for assembly using shear-block system or screw-spline system as recommended by manufacturer.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, 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. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Section 088000 "Glazing."

F. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:

a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).

c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.5 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

END OF SECTION 084113

SECTION 085113 ALUMINUM WINDOWS

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 Kawneer Architectural Aluminum Windows including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of window units.

1. Types of aluminum windows include:

a. Project-In and Project-Out Windows

1. Kawneer Series 8225TLF Thermal Windows

a. 2-1/4” (57.2mm) Overall System Depth
b. AW—PG90-AP

B. Related Sections:

1. 079200 “Joint Sealants”
2. 088800 “Glazing”

1.3 Definitions

A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufactures Association (AAMA) – AAMA Glossary (AAMA AG).

1.4 Performance Requirements

A. General Performance: Aluminum-framed window system shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Window Performance Requirements:

1. Performance Requirements: Provide aluminum windows of performance indicated that comply with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS). Performance Class and Grade;

b. Project-In and Project-Out Windows

1. 2-1/4” (57.2mm) Overall System Depth

a. AW—PG90-AP

2. Air leakage: The test specimen shall be tested in accordance with ASTM E283. Air leakage rate shall not exceed 0.10 cfm/ft^2 at a static air pressure differential of 6.2 psf (300 Pa). The test specimen shall meet the A3 rating of less than 0.55 (m^3/h)/m at 1.6 psf (75 Pa) when tested in accordance with CAN/CSA-A440-00 Windows.

3. Water Resistance: The test specimen shall be tested in accordance with ASTM E547 and ASTM E331. There shall be no leakage as defined in the test method at a static air pressure

differential of 15 psf (720 Pa). The test specimen shall meet the B7 rating with no water leakage at 15 psf (720 Pa) when tested in accordance with CAN/CSA-A440-00 Windows;

4. Uniform Load Deflection: A minimum static air pressure difference of 90 psf (4310 Pa) shall be applied in the positive and negative direction in accordance with ASTM E330. There shall be no deflection in excess of L/175 of the span of any framing member. The test specimen shall meet the C3, C4 or C5 rating when tested in accordance with CAN/CSA-A440-00 Windows.

    a. Project-In and Project-Out Windows:

        1. 2-1/4" (57.2mm) Overall System Depth
            a. AW-PG90-AP; 90 psf (4310 Pa)

5. Uniform Load Structural: A minimum static air pressure difference of 135 psf (6465 Pa) shall be applied in the positive and negative direction in accordance with ASTM E330. The unit shall be evaluated after each load with permanent set not to exceed 0.3% of span length.

    a. Project-In and Project-Out Windows:

        1. 2-1/4" (57.2mm) Overall System Depth

            a. AW-PG90-AP; 135 psf (6465 Pa)

6. Component Testing: Window components shall be tested in accordance with procedures described in AAMA/WDMA/CSA 101/I.S.2/A440 and AAMA 910.

7. Energy Efficiency:

    a. Thermal Transmittance (U-Factor): When tested to AAMA Specification 1503, AAMA Specification 507 or NFRC 100 the thermal transmittance (U-Factor) shall not be more than;

        1) 1" (25.4 mm) insulating glass:

            i. Project-Out: U-Factor not more than .48 BTU/hr/ft^2/°F per AAMA 1503 with exterior 3/16" (4.76 mm) clear glass, aluminum spacer, and interior 3/16" (4.76 mm) glass.

            ii. U-Factor not more than **0.45** BTU/hr/sf/°F per AAMA 507 or NFRC 100 when using project specified glass.

            iii. Project-In: U-Factor not more than .45 BTU/hr/sf/°F or ____ BTU/hr/sf/°F per AAMA 507 or NFRC100 when using project specified glass.

8. Condensation Resistance Test (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, the condensation resistance factor (CFR) shall not be less than;

    a. 1" (25.4 mm) clear insulating glass with aluminum spacer:

        1) Project-Out: CRF not less than 59 (frame) and 68 (glass).

        2) Project-In: Temperature Index (If) frame not less than 56.
            Temperature Index (Ig) glass not less than 68.

9. Temperature Index (I): Provide aluminum windows tested for thermal performance according to CSA-A440 with a Temperature Index (I) not less than:

    a. 1" (25.4 mm) clear insulating glass with aluminum spacer:

        1) Project-Out: (I) not less than 68 (frame) and 61 (glass).

10. Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC): When tested in accordance with AAMA Specification 1801, the STC and OITC shall not be less than;

    a. 1" (25.4 mm) insulating glass made with exterior 3/16" (4.76 mm) clear glass, 3/8" (9.52 mm) aluminum spacer, and interior 7/16" (11.11 mm) laminated clear glass:

        1) Project-Out: STC not less than 40; OITC not less than 34.

11. Forced Entry Resistance: All windows shall conform to ASTM F588, Grade 10.

C. Environmental Product Declarations (EPD): Shall have a Type III Product-Specific EPD created from a Product Category Rule.

D. Material Ingredient Reporting: Shall have a complete list of chemical ingredients to at least 100ppm (0.01%) that covers 100% of the product, acceptable documentation includes:

1. Manufacturer's inventory with Chemical Abstract Service Registration Number (CASRN or CAS#).

    a. Kawneer's Material Transparency Summary (MTS).

2. Cradle to Cradle certification: Either document below is acceptable for this option.

    a. radle to Cradle Certified™ with Material Health section Silver or above.

    b. ilver level or above Material Health Certificate.

3. Red List Free DECLARE label.

1.5 Submittals

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

1. Recycled Content:

    a. Provide documentation that aluminum has a minimum of 50% mixed pre- and post-consumer recycled content with a sample document illustrating project specific information that will be provided after product shipment.

    b. Once product has shipped, provide project specific recycled content information, including:

        1) Indicate recycled content; indicate percentage of pre- and post-consumer recycled content per unit of product.
        2) Indicate relative dollar value of recycled content product to total dollar value of product included in project.

3) Indicate location recovery of recycled content.
4) Indicate location of manufacturing facility.

2. Environmental Product Declaration (PPD):

a. Include a Type III Product-Specific EPD created from a Product Category Rule.

3. Material Ingredient Reporting:

a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100ppm (0.01%) that covers 100% of the product.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances and installation details.

C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.

D. Samples for Verification: For aluminum windows and components required.

E. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.

1.6 Quality Assurance

A. Installer Qualifications: An installer which has had successful experiences with installation of the same or similar units required for this project and other projects of similar size and scope.

B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.

C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum windows and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements." Do not modify size and dimensional requirements.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 Project Conditions

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 Warranty

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.

1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

2. Insulating Glass: Warranted to be free from defects (excluding breakage) for a period of five (5) years.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Basis-of-Design Product:

1. Kawneer Company Inc.

2. 8225 TLF™ Thermal Windows (Project-In and Project-Out)

3. 2-1/4" (57.2mm) Overall System Depth

a. AW—PG90-AP

B. Subject to compliance with requirements, provide a comparable product by the following:

1. Manufacturer: Oldcastle Building Envelope

a. Series: Signature Series 3375
b. Profile dimension: 3-3/8"
c. Performance Grade: AAMA/WDMA/CSA 101/I.S.2/A440-11

2. Manufacturer: EFCO
a. Series: WV-430
b. Profile dimensions: 3-1/2"

C. Substitutions: Refer to Substitutions Section for procedures and submission requirements.

1. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.

2. Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid window installation and construction delays.

3. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.

4. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for window system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum windows for a period of not less than ten (10) years. (Company Name)

5. Test Reports: Submit test reports verifying compliance with each test requirement required by the project.

6. Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.

D. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Contractor.

2.2 Materials

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.125" wall thickness at any location for the main frame and sash members.

1. Recycled Content: Shall have a minimum of 50% mixed pre- and post-consumer recycled content.

a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.

b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.

c. Indicate location recovery of recycled content.

d. Indicate location of manufacturing facility.

B. Thermal Barrier: The thermal barrier shall be Kawneer IsoLock™ with a nominal 3/8" (9.5 mm) separation consisting of a two-part, chemically curing high density polyurethane which is mechanically and adhesively bonded to the aluminum.

C. Fasteners: Nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.

D. Anchors: Nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

E. Fasteners: Non-magnetic stainless steel or other material warranted by the window manufacturer to be non-corrosive and compatible with the aluminum window members trim, hardware, anchors and other components of the window units. Do not use exposed fasteners except where unavoidable for application of operating hardware. Provide only exposed fasteners that match the finish of the window members and hardware being used. Exposed fasteners shall be Phillips flat-head screws.

F. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

2.3 Window System

A. 8225 TLF™ Thermal Windows - Project-In and Project-Out.

2.4 Glazing

A. Glass and Glazing Materials: Refer to Division 08 Section “Glazing” for glass units and glazing requirements applicable for four-sided structural silicone glazed aluminum window units.

B. Glazing System: Glazing method shall be a wet/dry type in accordance with manufacturer’s standards. Exterior glazing shall be silicone back bedding sealant. Interior glazing shall be

snap-in type glazing beads with an interior gasket in accordance with AAMA 702 or ASTM C864.

2.5 Hardware

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash weight and dimensions.

B. Project-In and Project-Out Windows: Provide the following operating hardware:

1. Locking:

a. Cast White Bronze Cam Locks (Standard)

b. Access Control Locks

c. Hook Lock Handle

d. Pivot Shoe Roto-Operator

2. Hinging:

a. 4-Bar Hinges (Standard)

b. Limit Stop

3. Other:

a. Pole Ring

b. Pole

2.6 Accessories

A. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, non-migrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.

B. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.

C. Sealants and joint fillers for joints at perimeter of window system as specified in Division 7 Section “Joint Sealants”.

D. Insect Screens: Extruded aluminum frames, 6063-T6 alloy and temper, joined at corners: 18 x 16 mesh aluminum screen cloth; frames finished to match aluminum windows; splines shall be extruded vinyl, removable to permit rescreening.

2.7 Fabrication

A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fit joints; make joints flush, hairline and weatherproof.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

B. Window Frame Joinery: Screw-Spline, Factory sealed frame and vent corner Joints

C. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

D. Fabricate aluminum windows that are re-glazable without dismantling sash or framing.

E. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

F. Sub frames: Provide sub frames with anchors for window units as shown, of profile and dimensions indicated but not less than 0.093" (2.4 mm) thick extruded aluminum. Miter or cope corners, and join with concealed mechanical joint fasteners. Finish to match window units. Provide sub frames capable of withstanding design loads of window units.

G. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 08 Section “Glazing” and with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS).

H. Glazing Stops: Provide snap-on glazing stops coordinated with Division 08 Section “Glazing” and glazing system indicated. Provide glazing stops to match frame.

2.8 Aluminum Finishes

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:

1. Kawneer Permafluor™ (70% PVDF), AAMA 2605, Fluoropolymer Coating (Color – Hartford Green).

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 work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight window installation.

1. Concrete Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install aluminum framed window system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tight construction.

D. Install aluminum framed window system and components to drain condensation, water penetrating joints, and moisture migrating within system to the exterior.

E. Separate aluminum from dissimilar materials to prevent corrosion or electrolytic action at points of contact.

3.3 Field Quality Control

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

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

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing Standard shall be per AAMA 502 including reference to ASTM E 783 for Air Infiltration Test and ASTM E 1105 for Water Penetration Test.

a. Air Infiltration Test: Conduct test in accordance with ASTM E 783 at a minimum uniform static test pressure of 6.2 psf (300 Pa) for AW. The maximum allowable rates of air leakage for field testing shall not exceed 1.5 times the project specifications.

b. Water Infiltration Test: Water penetration resistance tests shall be conducted in accordance with ASTM E 1105 at a static test pressure equal to 2/3 the specified water test pressure.

2. Testing Extent: Architect shall select window units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer’s representative present.

3. Test Reports: Shall be prepared according to AAMA 502.

3.4 Adjusting, Cleaning, And Protection

A. Adjust operating sashes, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weather tight closure. Lubricate hardware and moving parts.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 08 51 13

SECTION 087100 DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."**

1.2 SECTION INCLUDES

A. **Furnish and deliver all finish hardware necessary for all doors, also hardware as specified herein and as enumerated in hardware sets and as indicated and required by actual conditions at the building. The hardware shall include the furnishing of all necessary screws, bolts, expansion shields, drop plates, and all other devices necessary for the proper application of the hardware.**

1.3 RELATED SECTIONS

A. **Division 06 - Wood, Plastics, and Composites**

B. **Section 081113 - Hollow Metal Frames**

C. **Section 081416 - Flush Wood Doors**

D. **Section 087113 – Automatic Door Operators**

E. **Section 088000 - Glazing**

F. **Division 26 - Electrical**

G. **Specific Omissions: Hardware for the following is specified or indicated elsewhere, unless specifically listed in the hardware sets:**

1. ***Windows.***
2. ***Cabinets of all kinds, including open wall shelving and locks.***
3. ***Signs, except as noted.***

1.4 REFERENCES

A. **International Code Congress (ICC)/American National Standards Institute (ANSI):**

1. ***ICC/ANSI A117.1, Accessible and Usable Buildings and Facilities.***
2. ***ANSI/BHMA A156.1 – A156.24 – Standards for Hardware and Specialties.***

B. **National Fire Protection Association (NFPA):**

1. ***NFPA 80 - Standard for Fire Doors and Fire Windows***
2. ***NFPA 101 - Life Safety Code***

3. ***NFPA 105 - Smoke and Draft Control Door Assemblies***

C. **Underwriters Laboratories, Inc. (UL):**

1. ***UL 10C - Positive Pressure Test of Fire Door Assemblies***
2. ***UL 1784 - Air Leakage Tests of Door Assemblies***

D. **Applicable state and local building codes.**

E. **Accessibility**

1. ***ADA - Americans with Disabilities Act***
2. ***Rhode Island Accessibility Code – SBC-14, 15, 16***

F. **Door and Hardware Institute (DHI):**

1. ***Sequence and Format for the Hardware Schedule.***
2. ***Recommended Locations for Builders Hardware***

1.5 SUBMITTALS

A. **Submit under provisions of Section 01 33 00.**

B. **Product Data: Include manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.**

C. **Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:**

1. ***Type, style, function, size, and finish of each hardware item.***
2. ***Name and manufacturer of each item.***
3. ***Fastenings and other pertinent information.***
4. ***Location of each hardware set cross-referenced to indications on Drawings.***
5. ***Explanation of all abbreviations, symbols, and codes contained in schedule.***
6. ***Mounting locations for hardware.***
7. ***Mounting type for closers.***
8. ***Door and frame sizes, materials, degree of opening, handing, and fire/smoke rating.***
9. ***Name and phone number for the local manufacturer's representative for each product.***

D. **Key Schedule: After a keying meeting between representatives of the Owner, Architect, and the hardware supplier, provide a keying schedule, listing the levels of keying, as well as an explanation of the key system's function, the key symbols used, and the door numbers controlled. This schedule can be submitted as a part of the hardware schedule or as a separate schedule.**

E. **Samples: If requested by the Architect, submit samples of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule.**

1. ***Samples will be returned to the supplier in like-new condition. Units that are acceptable may, after final check of operations, be incorporated in the Work, within limitations of key coordination requirements.***

F. **Templates: After final approval of the hardware schedule, provide templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware.**

G. **Wiring Diagrams: After final approval of the hardware schedule, submit wiring diagrams as required for the proper installation of all electrical, electro-mechanical, and/or electro-magnetic products.**

H. **Operations and Maintenance Data: Provide in accordance with Section 01 78 23 and include the following:**

1. ***Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.***
2. ***Catalog pages for each product.***
3. ***Name, address, and phone number of local representatives for each manufacturer.***
4. ***Parts list for each product.***
5. ***Copy of final approved hardware schedule, edited to reflect "As installed."***
6. ***Copy of final keying schedule.***
7. ***As installed "Wiring Diagrams" for each opening connected to power, both low voltage and 110 volts.***
8. ***One (1) complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.***
9. ***Copy of warranties including appropriate reference numbers for manufacturers to identify the project.***

1.6 QUALITY ASSURANCE

A. **Substitutions: Submit substitutions in accordance with Division 01.**

B. **Supplier Qualifications: A recognized architectural hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an accredited Architectural Hardware Consultant (AHC), who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work for consultation.**

C. **Product Single Source Responsibility: Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer.**

D. **Supplier Single Source Responsibility: Procure hardware for all doors from a single supplier.**

E. **Electronic Security Hardware: When electrified hardware is included in the hardware specification, the hardware supplier must employ an individual knowledgeable in electrified components and systems, who is capable of producing wiring diagrams and consulting as needed. Coordinate installation of the electronic security hardware with the Architect and electrical engineers and provide installation and technical data to the Architect and other related sub-contractor. Upon completion of electronic security hardware installation, verify that all components are working properly, and state in the required guarantee that this inspection has been performed.**

1.7 DELIVERY, STORAGE AND HANDLING

A. **Tag each item or package separately with door number and corresponding hardware heading number as approved hardware submittal. Include basic installation instructions with each item or package.**

B. **Each article of hardware shall be individually packaged in manufacturer's original packaging.**

C. **Contractor will provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items so that completion of the Work will not be delayed by hardware losses both before and after installation.**

D. **Items damaged in shipment shall be replaced promptly and with proper material and paid for by whomever did the damage or caused the damage to occur.**

E. **All the hardware shall be handled at this project in a manner to avoid damage, marring or scratching. Any irregularities that occur to the hardware after it has been delivered to the project shall be corrected, replaced, or repaired by the Contractor at their expense. All hardware items shall be protected against malfunction due to paint, solvent, cleanser, or any chemical agent.**

F. **No direct shipments will be allowed unless approved by the Contractor.**

1.8 WARRANTY

A. **Starting date for warranty periods to be date of manufacture of that hardware item.**

B. **No liability is to be assumed where damage or faulty operation is due to improper installation, improper usage, or abuse.**

C. **Provide guarantee from hardware supplier as follows:**

1. ***Hinges: Limited Lifetime.***
2. ***Closers: Limited Lifetime.***
3. ***Locksets: Ten (10) years.***
4. ***Exit Devices: Five (5) years; except electrified hardware, one (1) year.***
5. ***All other Hardware: One (1) year.***

D. **Products judged to be defective during the warranty period shall be replaced or repaired in accordance with the manufacturer's warranty, at no additional cost to the Owner.**

1.9 MAINTENANCE

A. **Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.**

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Approval of manufacturers other than those listed shall be in accordance with Paragraph 1.6A.**

B. **Note that even though an acceptable substitute manufacturer may be listed, the product must provide all the functions and features of the specified product or it will not be approved.**

C. **Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.**

D. **Where the exact types of hardware specified are not adaptable to the finished shape or size of the members requiring hardware, furnish suitable types having as nearly as possible the same operation and quality as the type specified, subject to Architect's approval.**

2.2 MATERIALS

A. **Fasteners:**

1. ***Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.***
2. ***Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.***
3. ***Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent that no standard units of type specified are available with concealed fasteners. Do not use thru bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely.***
4. ***All hardware shall be installed with the fasteners provided by the hardware manufacturer.***

2.3 HINGES

A. **Provide five-knuckle, concealed bearing hinges of type, material, and height as outlined in the following guide for this specification:**

B. **1-3/4-inch-thick doors, up to and including 36 inches wide:**

1. **Exterior: standard weight, stainless steel, 4-1/2 inches high**

2. **Interior: standard weight, steel, 4-1/2 inches high**

C. **1-3/4-inch-thick doors over 36 inches wide:**

1. **Exterior: heavy weight, stainless steel, 5 inches high**

2. **Interior: heavy weight, steel, 5 inches high**

D. **Provide three hinges per door leaf for doors 90 inches or less in height, and one additional hinge for each 30 inches of additional door height.**

E. **Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:**

1. **Steel Hinges: Steel pins**

2. **Non-Ferrous Hinges: Stainless steel pins**

3. **Out-Swinging Exterior Doors: Non-removable pins**

4. **Out-Swinging Interior Lockable Doors: Non-removable pins**

5. **Interior Non-lockable Doors: Non-rising pins**

F. **The width of hinges shall be 4-1/2 inches at 1-3/4-inch-thick doors, and 5 inches at 2 inches or thicker doors. Adjust hinge width as required for door, frame, and/or wall conditions to allow proper degree of opening.**

G. **Acceptable manufacturers and/or products: Stanley CB series, Hager AB series, and McKinney TCA/T4CA series.**

2.4 ALUMINUM GEARED CONTINUOUS HINGES

A. **Provide aluminum geared continuous hinges conforming to ANSI A156.25, Grade 2.**

B. **Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with .25-inch diameter Teflon coated stainless steel hinge pin.**

C. **Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.**

D. **Hinges shall be capable of supporting door weights up to 450 pounds and shall be successfully tested for 1,500,000 cycles.**

E. **On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by a testing agency acceptable to the authority having jurisdiction.**

F. **Provide aluminum geared continuous hinges with electrified option where specified. Provide with sufficient number and gage of concealed wires to accommodate electric function of specified hardware.**

G. **Install hinges with fasteners supplied by manufacturer. Hole pattern shall be symmetrically patterned.**

H. **Acceptable manufacturers and/or products: Stanley 661HD series, Select SL11HD series.**

2.5 FLUSH BOLTS

A. **Provide automatic and manual flush bolts with forged bronze face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12-inch steel or brass rods at doors up to 90 inches in height. Top rods at manual flush bolts for doors over 90 inches in height shall be increased by 6 inches for each additional 6 inches of door height. Provide dust-proof strikes at each bottom flush bolt.**

B. **Acceptable manufacturers and/or products: Trimco, Burns, Don-Jo Mfg.**

2.6 CYLINDRICAL LOCKS - GRADE 1

A. **Provide cylindrical locks conforming to ANSI A156.2 Series 4000, Grade 1. Cylinders: Refer to 2.04 KEYING.**

B. **Provide locks with a standard 2-3/4 inches backset, unless noted otherwise, with a 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.**

C. **Provide locksets with a separate anti-rotation through bolts and shall have no exposed screws. Levers shall operate independently and shall have two external return spring cassettes mounted under roses to prevent lever sag.**

D. **Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.**

E. **Lever trim shall be solid cast levers without plastic inserts, and wrought roses on both sides. Locksets shall be thru bolted to assure proper alignment.**

1. ***Lever design shall be Best 14D.***
2. ***Lever trim on the secure side of doors serving rooms considered by the authority having jurisdiction to be hazardous shall have a tactile warning.***

F. **Acceptable manufacturers and/or products: Best 9K series.**

2.7 EXIT DEVICES

A. **Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit and/or Fire Exit Hardware.**

B. **Provide touchpad type exit devices, fabricated of stainless steel, plated to the standard architectural finishes to match the balance of the door hardware.**

C. **Touchpad shall extend a minimum of one half of the door width, but not the full length of the exit device rail.**

D. **Devices to incorporate a dead latching feature.**

E. **Provide manufacturer's standard strikes.**

F. **Provide exit devices cut to door width and height. Locate exit devices at a height recommended by the exit device manufacturer, allowable by governing building codes, and approved by the Architect.**

G. **Removable mullions shall be a 2 inches x 3 inches steel tube. Where scheduled, mullion shall be of a type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.**

H. **Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates.**

1. Lever style will match the lever style of the locksets.

I. **Exit devices for fire rated openings shall be UL labeled fire exit hardware.**

J. **Provide electrical options as scheduled.**

K. **Acceptable manufacturers and/or products: Precision Apex series.**

2.8 POWER SUPPLIES

A. **Provide power supplies, recommended, and approved by the manufacturer of the electrified locking component, for the operation of electrified locks, electrified exit devices, magnetic locks, electric strikes, and other components requiring a power supply.**

B. **Provide the appropriate quantity of power supplies necessary for the proper operation of the electrified locking component and/or components as recommended by the manufacturer of the electrified locking components with consideration for each electrified component utilizing the power supply, the location of the power supply, and the approved wiring diagrams. Locate the power supplies as directed by the Architect.**

C. **Provide a power supply that is regulated and filtered 24 VDC, or as required, and UL class 2 listed.**

D. **Provide a power supply complete requiring only 120VAC to the fused input and shall be supplied in an enclosure.**

E. **Provide a power supply with emergency release terminals, where required, that allow the release of all devices upon activation of the fire alarm system complete with fire alarm input for initiating "no delay" exiting mode.**

2.9 DOOR CLOSERS

A. **Provide door closers certified to ANSI/BHMA A156.4 Grade 1 requirements by a BHMA certified independent testing laboratory. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder. Cylinder body shall be 1-1/2-inch diameter.**

B. **Provide hydraulic fluid requiring no seasonal closer adjustment. Fluid shall be fireproof and shall pass the requirements of the UL10C "positive pressure" fire test.**

C. **Spring power shall be continuously adjustable over the full range of closer sizes and allow for reduced opening force as required by accessibility codes and standards. Closers shall have separate adjustment for latch speed, general speed, and backcheck.**

D. **Provide closers with heavy-duty forged forearms for parallel arm closers.**

E. **Closers shall not incorporate Pressure Relief Valve (PRV) technology.**

F. **Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other finish hardware items interfering with closer mounting.**

G. **Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.**

H. **Door closers meeting this specification: Stanley Commercial Hardware QDC100 series.**

2.10 PROTECTION PLATES

A. **Provide kick plates, and armor plates, minimum of 0.050 inch thick as scheduled. Furnish with machine or wood screws, finished to match plates. Sizes of plates shall be as follows:**

1. ***Kick Plates – 10 inches high x 2 inches less width of door on single doors, 1 inch less width of door on pairs***
2. ***Armor Plates – 36 inches high x 2 inches less width of door on single doors, 1 inch less width of door on pairs***

B. **Acceptable manufacturers and/or products: Trimco, Burns, Don-Jo Mfg.**

2.11 OVERHEAD STOPS

A. **Provide medium duty surface overhead stop for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking a wall, open against equipment, casework, sidelights, and/or where conditions do not allow a wall stop, or a floor stop presents a tripping hazard.**

B. **Acceptable manufacturers and/or products: Dorma, ABH Manufacturing, Glynn-Johnson.**

2.12 DOOR STOPS AND HOLDERS

A. **It shall be the responsibility of the hardware supplier to provide door stops for all doors in accordance with the following requirements:**

1. ***Use wall stops wherever possible, only on CMU walls.***
2. ***Where wall bumpers cannot be used, provide dome type floor stops of the proper height.***
3. ***At any opening where a wall or floor stop cannot be used, a heavy-duty overhead stop will be required.***

B. **Acceptable manufacturers and/or products: Trimco, Don-Jo Mfg., Burns.**

2.13 GASKETING

A. **Provide gasketing as specified.**

B. **Acceptable manufacturers and/or products: National Guard, Zero, Reese.**

2.14 SILENCERS

A. **Furnish "push-in" type silencers for each hollow metal or wood frame, three (3) for each single frame, two (2) for each pair frame. Omit where gasketing is scheduled.**

B. **Acceptable manufacturers and/or products: Trimco, Don-Jo Mfg., Burns.**

2.15 FINISHES

A. **With the exception of items listed below, the finish of hardware items shall be US26D - satin chrome.**

B. **Exceptions are as follows:**

1. ***Aluminum Geared Continuous Hinges: US28 (BHMA 628).***
2. ***Exit Devices: US32D (BHMA 630).***
3. ***Protection Plates: US32D (BHMA 630).***
4. ***Overhead Stops: Painted to Match.***
5. ***Door Closers: Powder Coat to Match.***
6. ***Weatherstripping: Clear Anodized Aluminum.***
7. ***Thresholds: Mill Finish Aluminum.***

2.16 CYLINDERS AND KEYING

A. **Provide a key system conforming to the Owner's existing key system and the following requirements:**

B. **Provide removable core cylinders at all keyed devices. The contractor will install contractor cores for the duration of the project. The general contractor will supply both the contractor cores and the final key cores. The temporary construction cores are to be returned to the manufacturer.**

C. **The manufacturers' agent shall meet with Owner and Architect to review keying requirements and lock functions prior to ordering finish hardware. Submit a keying schedule to Architect for approval.**

D. **Provide keys as follows:**

1. ***Three keys per core and/or cylinder.***
2. ***Two construction core control keys***
3. ***Two permanent core control keys***
4. ***Six construction master keys for each type (Contractor is to provide one set of construction keys to Architect)***

E. **Visual key control:**

1. ***Keys shall be stamped with their respective key set number and stamped "DO NOT DUPLICATE".***
2. ***Grand master and master keys shall be stamped with their respective key set letters.***
3. ***Do not stamp any keys with the factory key change number.***

4. Do not stamp any cores with key set on face (front) of Core. Stamp on back or side of cores so not to be visible when core is in cylinder.

F. **Deliver change keys, and/or key blanks from the factory or directly to the Owner in sealed containers, return receipt requested. Failure to comply with these requirements may be caused to require replacement of all or any part of the keying system that was compromised at no additional cost to the Owner.**

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Prior to installation of any hardware, examine doors, frames, walls, and related items for conditions that would prevent proper installation of finish hardware. Correct defects prior to proceeding with installation.**

B. **Pre-Installation Conference: Prior to the installation of hardware, manufacturer's representatives for locksets, closers, and exit devices shall arrange and hold a jobsite meeting to instruct the installing contractor's personnel on the proper installation of their respective products. A letter of compliance, indicating when the meeting was held and who was in attendance, shall be sent to Architect and Owner.**

3.2 INSTALLATION

A. **Hardware shall be installed by qualified tradesmen skilled in application of commercial grade hardware. For technical assistance if necessary, installers may contact manufacturer's representative for the item in question, as listed in the hardware schedule.**

B. **Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.**

C. **Install each hardware item in compliance with the manufacturer's instructions and recommendations, using only the fasteners provided by the manufacturer.**

D. **Do not install surface mounted items until finishes have been completed on the substrate. Protect installed hardware during painting.**

E. **Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.**

F. **Operating parts shall move freely and smoothly without binding, sticking, or excessive clearance.**

G. **Set thresholds for exterior doors in full bed of butyl rubber or polyisobutylene mastic sealant complying with requirements specified in Section 07 92 00.**

3.3 ADJUSTING, CLEANING AND DEMONSTRATING

A. **Adjust and check each operating item of hardware and each door, to insure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly.**

B. **Where door hardware is installed more than one (1) month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make a final check and adjustment of hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.**

C. **Clean adjacent surfaces soiled by hardware installation. Remove bulk trash form the building, clean up any dust/debris caused by the installation of hardware.**

D. **Instruct Owner's personnel in the proper adjustment, lubrication, and maintenance of door hardware and hardware finishes.**

3.4 FIELD QUALITY CONTROL

A. **At completion of the project, a qualified factory representative for the manufacturers of locksets, closers, and exit devices shall inspect installations of their products. After the inspections, a letter shall be sent to the Architect reporting on conditions, verifying that their respective products have been properly installed and adjusted.**

B. **Six-Month Adjustment: Approximately six months after the date of Substantial Completion, the installer, accompanied by representatives of the manufacturers of latch sets and locksets, door control devices, and of other major hardware suppliers, shall return to the Project to perform the following work:**

1. ***Examine and re-adjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.***
2. ***Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures.***
3. ***Replace hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units.***
4. ***Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.***

3.5 PROTECTION

A. **Provide for the proper protection of items of hardware until Owner accepts the project as complete. Damaged or disfigured hardware shall be replaced or repaired by the responsible party.**

3.6 HARDWARE SCHEDULE

A. **Provide hardware for each door to comply with requirements of hardware set numbers indicated in door schedule, and in the following schedule of hardware sets.**

B. **It is intended that the following schedule includes all items of finish hardware necessary to complete the work. If a discrepancy is found in the schedule, such as a missing item, improper hardware for a frame, door or fire codes, the preamble will be the deciding document.**

C. **Hardware sets:**

SET #01 – PAIR AT STORAGE – STOREROOM LOCK

6	Butt Hinge	CB179 NRP SERIES AS SPECIFIED	26D	ST
2	Manual Flushbolt	3917-12	626	TR
1	Storeroom Lock	9K3-7D14D 7/8” LTC	626	BE
2	Overhead Stop	700S	689	DM
2	Door Silencers	1229A	GREY	TR

SET #02 – PAIR AT CYBER LOBBY – CARD READER

5	Butt Hinge	CB179 NRP SERIES AS SPECIFIED	26D	ST
1	Butt Hinge – Electric	CE-18 CB179 SERIES AS SPECIFIED	26D	ST
1	Set - Automatic Flush Bolt	3810 X 3810	626	TR
1	Electric Lock	9KW3-7DEU14D RQE 7/8” LTC	626	BE
1	Coordinator	3094B2	Silver	TR
2	Door Closer	QDC113 R	689	SH
2	Kick Plate	K0050 10" X 1" LDW B4E-HEAVY-KP CSK	630	TR
3	Door Silencers	1229A	GREY	TR
1	Power Supply	DKPS-2A		RC
1	Card Reader	PROVIDED/SPECIFIED BY SECURITY VENDOR		
1	Door Contact	PROVIDED/SPECIFIED BY SECURITY VENDOR		

NOTE: ALL WIRING AND CONNECTIONS BY DIVISION 26 & 28.
OPERATIONAL DESCRIPTION:
IMMEDIATE EGRESS ALWAYS ALLOWED. ACCESS BY KEY OR CARD. REQUEST TO EXIT AND DOOR CONTACT SWITCHES TO BE CONNECTED TO BUILDING'S SECURITY SYSTEM. UPON POWER FAILURE ACCESS ONLY BY KEY.

SET #03 - SINGLE AT CYBER ROOM – PUSH PULL

1	Continuous Hinge	661HD	AL	ST
1 St	Push/Pull Bars	1746 X LENGTH AS REQUIRED	630	TR
1	Roller Latch	1704	626	DO
1	Overhead Stop	910S	689	DM

SET #04 – PAIR AT MULTI-PURPOSE – CLASSROOM LOCK

6	Butt Hinge	CB179 SERIES AS SPECIFIED	26D	ST
2	Manual Flushbolt	3917-12	626	TR
1	Classroom Lock	9K3-7R14D 7/8” LTC	626	BE
1	Closer	QDC111 BF R REG MOUNT @ ACT LEAF	689	SH
2	Overhead Stop	910S	689	DM
2	Kick Plate	K0050 10" X 1" LDW B4E-HEAVY-KP CSK	630	TR
2	Door Silencers	1229A	GREY	TR

SET #05 – SINGLE AT MULTI-PURPOSE – CLASSROOM LOCK

3	Butt Hinge	CB179 SERIES AS SPECIFIED	26D	ST
1	Classroom Lock	9K3-7R14D	626	BE
1	Closer	QDC113 BF R REG MOUNT	689	SH
1	Kick Plate	K0050 10" X 2" LDW B4E-HEAVY-KP CSK	630	TR

3	Door Silencers	1229A	GREY	TR

SET #06 – SINGLE AT G/NEUTRAL SHOWER – PRIVACY LATCH

3	Butt Hinge	CB179 SERIES AS SPECIFIED	26D	ST
1	Privacy Latch w/Indicator	M1047 LCB	626	DM
1	Closer	QDC111 BF R REG MOUNT	689	SH
1	Overhead Stop	910S	689	DM
1	Kick Plate	K0050 10" X 2" LDW B4E-HEAVY-KP CSK	630	TR
3	Door Silencers	1229A	GREY	TR

SET #07 – SINGLE AT STORAGE – STOREROOM LOCK

3	Butt Hinge	CB179 SERIES AS SPECIFIED	26D	ST
1	Storeroom Lock	9K3-7D14D	626	BE
1	Closer	QDC111 BF R REG MOUNT	689	SH
1	Door Stop	1211/1270CV AS REQUIRED	626	TR
1	Kick Plate	K0050 10" X 2" LDW B4E-HEAVY-KP CSK	630	TR
3	Door Silencers	1229A	GREY	TR

SET #08 – SINGLE AT STAIR – PANIC DEVICE PASSAGE FUNCTION

3	Butt Hinge	CB179 SERIES AS SPECIFIED	26D	ST
1	Fire Panic Device	FL2114 x 4914D	630	PR
1	Closer	QDC111 BF R REG MOUNT	689	SH
1	Door Stop	1211/1270CV AS REQUIRED	626	TR
1	Kick Plate	K0050 10" X 2" LDW B4E-HEAVY-KP CSK	630	TR
1 St	Smoke Seal	5050B X HEAD AND JAMBS		NA

SET #09 - PAIR AT MULTI-PURPOSE K-12 – PANIC DEVICE CLASSROOM FUNCITON

6	Hinges	CB168 NRP SERIES AS SPECIFIED	US26D	ST
1	Exit Device	2203 X 4903D CD LBR	630	PR
1	Exit Device	2201 X 4903D CD LBR	630	PR
1	Rim Cylinder	AS REQUIRED	626	BE
2	Mortise Cylinder	AS REQUIRED	626	BE
2	Door Closer	QDC115 BF R	689	SH
2	Kick Plate	K0050 10" X 1" LDW B4E-HEAVY-KP CSK	630	TR
2	Door Stop	1211/1270CV AS REQUIRED	626	TR
2	Door Silencers	1229A	GREY	TR

SET #10 – ETR DOOR – NEW AUTOMATIC OPERATOR

1	Electric Strike	0162 24VDC Fail Secure	US32D	RCI
1	Automatic Operator	Specified in Section 087113		

NOTE: ALL WIRING AND CONNECTIONS BY DIVISION 26 & 28.
ELECTRIC STRIKE TO BE POWERED BUY AUTOMATIC OPERATOR.
PUSH BUTTONS TO BE TIED INTO ACCESS CONTROL SYSTEM TO CONTROL WHEN ACCESS TO SPACE IS RESTRICTED.

SET #11 – ETR STAIR DOOR – LOCAL ALARM

1	Fire Panic Device	FL2103 X E4908D X ALW	630	PR
1	Rim Cylinder	AS REQUIRED FOR LEVER TRIM	626	BE
1	Mortise Cylinder	AS REQUIRED FOR ALARM	626	BE
1	Power Supply	DKPS-2A		RC
1	Armored Door Loop	EPT-2		PR
2	Card Reader	PROVIDED/SPECIFIED BY SECURITY VENDOR		
1	Door Contact	PROVIDED/SPECIFIED BY SECURITY VENDOR		

NOTE: ALL WIRING AND CONNECTIONS BY DIVISION 26 & 28.
LOCAL ALARM INTEGRAL TO EXIT DEVICE CAN BE ACTIVATED BY CYLINDER ON EXIT DEVICE RAIL. ALARM CAN BE BY-PASSED BY CARD READER OR KEY; EGRESS THROUGH DOOR WITHOUT CARD OR KEY WILL ACTIVATE ALARM; ALARM WILL SOUND UNTIL DE-ACTIVATED BY KEY ON EXIT DEVICE RAIL. THERE IS NO DELAY FOR EGRESS ONLY ALARM.

SET #12 – ETR EXTERIOR DOOR

1	Door Contact	PROVIDED/SPECIFIED BY SECURITY VENDOR		

SET #13 – ETR DOOR – NEW CARD READER

1	Electric Strike	0162 24VDC Fail Secure	US32D	RCI
1	Power Supply	DKPS-2A		RC
1	Card Reader	PROVIDED/SPECIFIED BY SECURITY VENDOR		
1	Door Contact	PROVIDED/SPECIFIED BY SECURITY VENDOR		

NOTE: ALL WIRING AND CONNECTIONS BY DIVISION 26 & 28.
EGRESS ALWAYS POSSIBLE BY EXISTING EXIT DEVICE; ACCESS BY KEY OR CARD READER. CONFIRM DOOR IS ALWAYS LOCKED ON PULL SIDE; CONFIRM ELECTRIC STRIKE SPECIFIED IS COMPATIBLE WITH EXISTING EXIT DEVICE. ADVISE ARCHITECT IF ANY CONFLICTS PRIOR TO ORDERING HARDWARE.

SET #14 - EXTERIOR - PAIR - ENTRY – CARD READER

2	Continuous Hinge	661HD UL W/EPT PREP	AL	ST
1	Removable Mullion	KR 822	600	PR
1	Exit Device	C MLR TS 2103 X 1703 LD	630	PR
1	Exit Device	C MLR TS 2102 X 1701 LD	630	PR
1	Rim Cylinder	AS REQUIRED	626	BE
1	Mortise Cylinder	AS REQUIRED FOR MULLION	626	BE
2	Door Closer	QDC113 R	689	SH
2	Drop Plate/Spacers/Brackets	AS REQUIRED	689	SH
1	Card Reader	PROVIDED/SPECIFIED BY SECURITY VENDOR		
2	Door Contact	PROVIDED/SPECIFIED BY SECURITY VENDOR		
1	Power Supply	RPSMLR2		PR
2	Power Transfer	EPT-12C		PR
2	Harness	WH-192		ST
2	Harness	WH-6E		ST
2	Harness	WHXX-P (LENGTH AS REQUIRED)		ST
2	Door Sweep	C627 A (DOOR WIDTH)		NA
1	Door Seals	706E X HEAD AND JAMBS	AL	NA
1	Mullion Seal	5100 X MULLION HEIGHT		NA
1	Threshold - Bumper Seal	1/2" HIGH X JAMB DEPTH X OPENING WIDTH - PAIR	AL	NA

NOTE: ALL WIRING AND CONNECTIONS BY DIVISION 26 & 28.
OPERATIONAL DESCRIPTION:
IMMEDIATE EGRESS ALWAYS ALLOWED. ACCESS BY KEY OR BY CARD READER. CARD READER WILL RETRACT EXIT DEVICE LATCHBOLTS AND ALLOW ACCESS. REQUEST TO EXITS AND DOOR CONTACTS TO BE CONNECTED TO BUILDING'S SECURITY SYSTEM.

SET #15 - EXTERIOR - SINGLE - ENTRY – CARD READER

1	Continuous Hinge	661HD	AL	ST
1	Exit Device	C MLR TS 2103 X 1703 LD	630	PR
1	Rim Cylinder	AS REQUIRED	626	BE
1	Door Closer	QDC113 R	689	SH

1	Drop Plate/Spacers/Brackets	AS REQUIRED	689	SH
1	Card Reader	PROVIDED/SPECIFIED BY SECURITY VENDOR		
1	Door Contact	PROVIDED/SPECIFIED BY SECURITY VENDOR		
1	Power Supply	RPSMLR2		PR
1	Power Transfer	EPT-12C		PR
1	Harness	WH-192		ST
1	Harness	WH-6E		ST
1	Harness	WHXX-P (LENGTH AS REQUIRED)		ST
1	Door Sweep	C627 A (DOOR WIDTH)		NA
1	Mullion Seal	5100 X MULLION HEIGHT		NA
1	Threshold - Bumper Seal	1/2" HIGH X JAMB DEPTH X OPENING WIDTH - PAIR	AL	NA

NOTE: ALL WIRING AND CONNECTIONS BY DIVISION 26 & 28.
OPERATIONAL DESCRIPTION:
IMMEDIATE EGRESS ALWAYS ALLOWED. ACCESS BY KEY OR BY CARD READER. CARD READER WILL RETRACT EXIT DEVICE LATCHBOLTS AND ALLOW ACCESS. REQUEST TO EXITS AND DOOR CONTACTS TO BE CONNECTED TO BUILDING'S SECURITY SYSTEM.

END OF SECTION 08 71 00

SECTION 08 71 13 – AUTOMATIC DOOR OPERATORS

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 includes the following types of automatic door operators:
   1. Low-energy door operators for swinging doors.

B. Related Sections:
   1. Division 7 Sections for sealants to the extent not specified in this section.
   2. Division 8 Sections for “Aluminum-Framed Entrances and Storefronts” for entrances furnished and installed separately in Division 8 Section.
   3. Division 8 Section “Door Hardware” for hardware to the extent not specified in this section.
   4. Division 8 Section “Glazing” for materials and installation requirements of glazing for automatic entrances.
   5. Division 26 and 28 Sections for electrical connections including conduit and wiring for automatic entrance operators and access-control devices.

1.3 REFERENCES

A. References: Comply with the version year adopted by the Authority Having Jurisdiction.
   1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
   2. ICC/IBC - International Building Code.
   3. CUL – Approved for use in Canada.
   4. NFPA 70 - National Electrical Code.
   5. NFPA 80 - Fire Doors and Windows.
   6. NFPA 101 - Life Safety Code.
   7. NFPA 105 - Installation of Smoke Door Assemblies.

B. American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA).
   1. ANSI/BHMA A156.19 Standards for Power Assist and Low Energy Power Operated Doors.

C. Underwriters Laboratories (UL).
   1. UL10C – Positive Pressure Fire Tests of Door Assemblies.
   2. UL 325 - Standard for Safety for Door, Drapery, Gate, Louver, and Window Operators and Systems.

D. American Association of Automatic Door Manufacturers (AAADM).

E. American Society for Testing and Materials (ASTM).
   1. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
   2. ASTM B209 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

F. American Architectural Manufacturers Association (AAMA).
   1. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.

G. National Association of Architectural Metal Manufacturers (NAAMM).
   1. Metal Finishes Manual for Architectural Metal Products.

H. International Code Council (IBC).
   1. IBC: International Building Code Building Code.

1.4 DEFINITIONS

A. Activation device: Device that, when actuated, sends an electrical signal to the door operator to initiate the door operation.

B. Monitored Safety Devices: A tested system that works in conjunction with the automatic door control that detects the presence of a person or an object within a zone where contact could occur and provides a signal to stop the movement of the door.

C. AAADM: American Association of Automatic Door Manufacturers.

D. Operating ambient Temperature Range: 5 Degrees F to plus 122 degrees F (minus 15 C to 50 degrees C).

E. For automatic door terminology, refer to ANSI/BHMA A 156.19 for definitions of terms.

1.5 PERFORMANCE REQUIREMENTS

A. General: Provide automatic doors that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturers corresponding systems.

B. Compliance:
   1. ICC/IBC International Building Code
   2. ANSI/BHMA A 156.19 American National Standard for Power Operated Doors Pedestrian Doors.
   3. UL 325 Listed
   4. NFPA 70 National Electrical Code.
   5. NFPA 101 Life Safety Code
   6. CUL Approved for use in Canada
   7. UL Listed Fire Door Operator with Automatic Closer

C. Automatic Door equipment accommodates medium to heavy pedestrian traffic.

D. Opening Force Requirements:
   1. Power-Operated swinging doors shall open with a manual force not to exceed 30 lbf (133N) to set the door in motion and 15 lbf to fully open the door with force applied at 1” (25mm) from the latched edge of the door. The required force to prevent a stopped door from opening or closing shall not exceed 15 lbf (67N) measured 1” (25mm) from the latch edge of the door at any point during the opening or closing.

E. Closing Time:

1. Door operators shall be field adjustable to close 90 degrees to 10 degrees in 3 seconds or longer per ANSI/BHMA A 156.19 standard.
2. Door shall be field adjusted to close from 10 degrees to fully closed position in not less than 1.5 seconds.

1.6 SUBMITTALS

A. Comply with Division 01 – Submittal Procedures.

B. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles fabrication, operational descriptions and finishes.

C. Shop Drawings: For automatic entrances. Include plans, elevations, sections, details, hardware mounting heights, additional accessories and attachments to other work.

D. Samples: color samples of exposed finish as required.

E. Informational Submittals: Manufacturers product information and applicable sustainability program credits that are available towards a LEED rated product certification.
1. Credit MR 4.1 and 4.2: Manufacture's or fabricator's certificate indicating percentage of post-consumer recycled content by weight and pre-consumer recycled content by weight for each product specified under this section.

F. Manufacturers Field Reports: Submit manufacturer's field reports from AAADM certified technician of inspection and approval of doors for compliance with ANSI/BHMA A 156.19 after completion of installation.

G. Operating and Maintenance Manuals: Provide manufacturers operating, owners and maintenance manuals for each item specified as required in Division 01, Closeout Submittals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: 10 years minimum of documented experience in manufacturing door equipment similar to that indicated within this specification with a proven record of successful service performance. A manufacturer with company certificate issued by AAADM.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 5 years documented experience installing and maintenance of units similar in material, design, and extent to that indicated in this specification and whose work has resulted in construction with a record of successful in-service performance. Manufacturer's authorized representative who is trained and approved for installation and maintenance of units by AAADM required for this Project

C. Source Limitations for Automatic Operators: Obtain each type of automatic door operator and senor components specified in this section from single source from single manufacturer.

D. 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.

E. Power-Operated Door Standard: ANSI/BHMA A 156.19 Current year.

F. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrances serving as a required means of egress.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings to receive automatic entrances by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate door operators with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of project.

B. Electrical System Roughing-in: Coordinate layout and installation of automatic power door operator with connections to power supplies and access-control system.

1.10 WARRANTY

A. Automatic Door Operators to be free of defects in material and workmanship for a period of Two (2) years from the date of substantial completion.

B. Safety Sensors to be free of defects in material and workmanship for a period of One (1) year from the date of substantial completion.

C. During the warranty period a factory trained technician shall preform service and affect repairs. A safety inspection shall be performed after each adjustment or repair and a completed inspection form submitted to the owner.

D. During the warranty period all warranty work shall be performed during normal working hours.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. dormakaba • Reamstown, PA • 1-844-SPEC-NOW (1-844-773-2669) • Website: www.dormakaba.us

B. Substitutions: Stanley Magic Force 700lbs, Assa SW200 700 lbs.

2.2 AUTOMATIC SWING DOOR OPERATOR

A. Model: dormakaba, ED Series ED250 (Basis of Design) An Integrated, self-learning automatic swing door operator with an advanced CPU, a multistage gearbox with real time adaptive software and available user interface.
   1. Automatic Door Configuration:
      a. Configuration: Single swing door or pair of doors swinging.
      b. Traffic Pattern**:** Two-way.

c. Mounting: Overhead Concealed Operator x Overhead Concealed Closer with Full Length Cover

B. Mounting: Overhead Concealed Operator x Overhead Concealed Closer with Full Length Cover Control Features
1. Power-hold Close
2. Built in Lock Delay
3. On-Off-Hold Open switch control to control door function, (Automatic-Hold Open- Exit Only)
4. On-Off Power Switch
5. Fire Alarm Integration
6. Field Adjustable Handing
7. Push and Go
8. Power Assist Opening Activation
9. Intergraded Connections for Monitored Safety Sensors and other accessories.
10. Integrated access control

C. Door Control Features
1. Wind Load and Stack Pressure microprocessor monitored with power boost to ensure secure opening and closing in changing conditions.
2. Door Weight Max. ED 250 - 800 lbs.

D. Header Size: Narrow header at 4” height by 6” depth

2.3 ACTIVATION DEVICES

A. Activation Device:
1. Push Plate: Jamb mounted, hard wired, 1-1/2 inch x 4-3/4 inch, stainless steel push plate switches engraved with "Push to Open" with a handicap logo.

2.4 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. Door Mounted Sensor System) DMS as specified:
1. Door Mounted Presence Sensor (DMS): Door mounted infrared presence Sensor mounted on the approach or push side of the door. Each module within the sensor housing shall detect a 28” (50.8 cm) minimum high person. The sensor shall be mounted at the top rail of the door(s). System will reactivate a closing door.

2.5 ELECTRICAL

A. Electrical 115 V AC +/- 10% 50/60 Hz 6.6 A max.

2.6 ALUMINUM FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Anodized Finish:
   1. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm.

EXECUTION

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames with Installer present, for compliance with requirements for installation tolerances, wall and floor construction and other conditions affecting performance of automatic entrances.

B. Examine roughing in for electrical source power to verify actual locations of wiring connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
   1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
   2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.

C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections.

D. Sealants: Comply with requirements specified in Division 07 Section "Joint Sealants" to provide seal between the operator housing and wall surface. installation.

E. Signage: Apply signage on both sides of each door and each sidelight as required by ANSI/BHMA A 156.19

3.3 FIELD QUALITY CONTROL

A. Manufacturer’s representative shall provide technical assistance and guidance for installation of automatic doors.
   1. Factory trained and AAADM certified representative shall test and inspect each automatic door to determine compliance of the installed system to ANSI/BHMA A 156.19

3.4 ADJUSTING

A. Adjust door operators and controls for smooth and safe operation.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by automatic operator installation promptly after installation .

3.6 DEMONSTRATION

A. Engage a factory authorized representative to train Owner's maintenance personnel to adjust, operate, and maintain safe operation of automatic entrances.

3.7 HARDWARE SETS

Set #1 - VESTIBULE - AUTO OPERATOR
Doors: 100, 101

1	Door Operator	ED250LE S NH	F1	DKO
2	Operator Switch	940 HP	32D	RCI

END OF SECTION 087113

SECTION 088000 - GLAZING

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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Storefront framing.
4. Glazed entrances.
5. Interior borrowed lites.
6. Mirrors

B. Related Sections:
1. Section 081416 “Flush Wood Doors”
2. Section 084113 “Aluminum Entrances and Storefronts
3. Section 085113 “Aluminum Windows”

1.3 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 C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. The building is located in a Wind-Bourne Debris region per RISBC because it is located within 1 mile of the coastal mean high-water line and the basic wind speed for Providence exceeds 130 mph. The building’s exterior wall glazing will therefore be required to comply with the requirements of RISBC 1609.1.2, Protection of openings. The glazing will be impact resistant or protected with an impact-resistant covering meeting missile test of ASTM E1996.

B. 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.

C. Delegated Design: Design glass, including comprehensive engineering analysis according to the Rhode Island State Building Code (11th Edition) by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.
2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure such that the deflection will not result in loss of edge support.
4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of the following products; 12 inches (300 mm) square.

1. Fire-resistive glazing products.
2. Insulating glass.

C. Glazing Accessory Samples: For gaskets, sealants and colored spacers, in 12-inch (300-mm) lengths.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation and licensed in the State of Rhode Island.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installers and manufacturers of insulating-glass units with sputter-coated, low-e coatings.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass and insulating glass.

D. Preconstruction adhesion and compatibility test report.

E. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.

B. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

D. Source Limitations for Glass: Obtain insulating glass from single source from single manufacturer for each glass type.

E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

F. 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's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

G. Safety Glazing Labeling: Permanently mark each pane of glazing with certification label of the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies. The label shall be acid-etched, sandblasted, ceramic fired, laser etched, embossed or of a type that once applied cannot be removed without being destroyed.

H. Fire-Protection-Rated Glazing Labeling: Permanently mark each pane of fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes. The label shall be acid-etched, sandblasted, ceramic fired, laser etched, embossed or of a type that once applied cannot be removed without being destroyed.

I. When glazing is required to be safety and fire protection rated, both labels shall be applied to each plane of glass.

J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

K. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install glazing in mockups specified in Section 084113 "Aluminum Entrances and Storefronts" to match glazing systems required for Project, including glazing methods.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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 recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 PROJECT 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 below 40 deg F (4.4 deg C).

1.11 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which 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 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning

insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

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.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.
3. For coated vision glass, comply with requirements for Condition C (other coated glass).

C. Fully Tempered (Kind FT):

1. Clear.
2. Thickness as indicated on Drawings or as required for location.
3. Provide safety glazing label.

2.3 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven

record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written recommendations.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

B. Glass Type: Clear laminated glass with two plies of heat-strengthened float glass.

1. Thickness of Each Glass Ply: As required to provide overall thickness as indicated on Drawings.
2. Interlayer Thickness: 0.060 inch (1.52 mm).
3. Provide safety glazing labeling.

2.4 INSULATING GLASS

A. Basis-of-Design Product: Subject to compliance with requirements, provide insulated glass units as manufactured by Viracon. Comparable products by alternate manufacturers are acceptable subject to compliance with the quality and performance standards established by the specified Product.

B. Insulating Vision Glass (Glass Type 1 – GL1):

1. Type: Viracon VNE 1-63.
2. Outdoor Lite: ¼ inch clear with Low-E coating on the No. 2 surface.
3. Air Space: ½ inch, argon filled.
4. Indoor Lite: ¼” clear.
5. Visible Light Transmittance: 62%.
6. Winter Nighttime U-Factor: 0.25.
7. Summer Daytime U-Factor: 0.21.
8. Solar Heat Gain Coefficient (SHGC): 0.28.
9. Shading Coefficient: 0.33.
10. Outdoor Visible Light Reflectance: 10%.
11. Tempered glass as indicated or required by Code. Provide safety glazing label.

2.5 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from[**one of**] the following:

1. EPDM complying with ASTM C 864.
2. Silicone complying with ASTM C 1115.
3. Thermoplastic polyolefin rubber complying with ASTM C 1115.
4. Neoprene complying with ASTM C 864.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will 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.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

2.7 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 C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. 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.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Provide tempered glass:

1. Where indicated on the Drawings.
2. As required by the Rhode Island State Building Code for Hazardous Locations.
3. As required by the glass manufacturer.

C. Provide temporary protection of exposed frit coatings on the No. 4 surface during fabrication. Temporary protection to remain in place for delivery and installation.

D. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

E. Grind smooth and polish exposed glass edges and corners.

2.10 MIRRORS

A. Glass Mirrors: ASTM C1503.

B. Clear Glass: Mirror Select Quality; 6.0 mm nominal thickness.

C. Mirror Mastic: Adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

D. Film Backing: Film backing and pressure-sensitive adhesive; both compatible with mirror backing as certified by mirror manufacturer. Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-bakcing manufacturer to produce a surface free of bubbles, blisters and other imperfections.

E. Edge Treatment: Round polished.

F. Hardware: Top and bottom aluminum J-channel extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

PART 3 - EXECUTION

3.1 EXAMINATION

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 will 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. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. 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.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. 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 according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. 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.

L. 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 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 and then to jambs. Cover horizontal framing joints by applying tapes to jambs and 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 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 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.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. 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; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Remove temporary protection from No. 4 surfaces containing exposed frit until just before cleaning. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

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. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For firestop tracks, from ICC-ES.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.

B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.

1. Steel Studs and Runners:

   a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
   b. Depth: As indicated on Drawings.

2. Dimpled Steel Studs and Runners:

   a. Minimum Base-Metal Thickness: 0.025 inch (0.64 mm).
   b. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner 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. Products: Subject to compliance with requirements, available Products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
      2) MBA Building Supplies; FlatSteel Deflection Track; Slotted Deflecto Track.
      3) Steel Network Inc. (The); VertiClip SLD; VertiTrack VTD Series.
      4) Superior Metal Trim; Superior Flex Track System (SFT).

D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the 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. Products: Subject to compliance with requirements, available Products that may be incorporated into the Work include, but are not limited to, the following:

   a. Dietrich Metal Framing; The System by Metal-Lite, Inc.
   b. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).

F. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 1-1/2 inches (38 mm) or as indicated on Drawings.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
2. Depth: 7/8 inch (22.2 mm) or as indicated on Drawings .

H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to [**10**] <**Insert number**> times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings.

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Runners: ASTM C 645.
    a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
    b. Depth: As indicated on Drawings.
3. Dimpled Steel Studs and Runners: ASTM C 645.
    a. Minimum Base-Metal Thickness: 0.025 inch (0.64 mm).
    b. Depth: As indicated on Drawings.
4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
    a. Minimum Base-Metal Thickness**:** 0.033 inch (0.84 mm).

5. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.

    a. Configuration: Asymmetrical or hat shaped.

G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

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. Armstrong World Industries, Inc.; Drywall Grid Systems.
    b. Chicago Metallic Corporation; Drywall Grid System.
    c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. 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 and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, 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, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.

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 tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating 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 runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:

1. Screw to wood framing.
2. 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. Z-Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-furring members spaced 24 inches (610 mm).

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.4 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

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. Acoustic mullion trim.
   3. Reveal trim.

B. Related Requirements:

   1. Section 017419 “Construction Waste Management Plan” for provision of waste management.
   2. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
   3. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 C 840 requirements or gypsum board manufacturer's written recommendations, 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, those that are moisture damaged, and those that are 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.

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.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that be incorporated into the Work include, but are not limited to, the following:

1. Georgia-Pacific Gypsum LLC
2. LaFarge North America Inc.
3. National Gypsum Company.
4. USG Corporation.

B. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.

1. Thickness: 5/8” (15.9 mm).
2. Long Edges: Tapered.

D. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 1.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.
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 (Exposed trim is not permitted unless noted otherwise on the Drawings:

a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. Expansion (control) joint.
f. Curved-Edge Cornerbead: With notched or flexible flanges.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

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 setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. 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.

D. 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.

E. Acoustical Joint 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. Products: Subject to compliance with requirements, available Products that may be incorporated in the Work include, but are not limited to, the following:

    a. Percora Corporation; AC-20 FTR
    b. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
    c. USG Corporation; SHEETROCK Acoustical Sealant.
    d. Tremco Commercial Sealants & Waterproofing; Tremco Acoustical Sealant, Tremco Acylic SP.

F. Acoustic Mullion Trim: Model 55 Classic Mullion Trim Cap as manufactured by MULL-it-OVER Products.

1. Aluminum Extrusion: 0.125 inches thick.
2. Sound Absorbing Foam:

    a. Resistant to smoke, flame and microbial growth.
    b. Fire Rating: ASTM E84 Class 1.
    c. Fungi Resistance: Zero rating per ASTM G21.
3. Compressible Foam: Between edge of extrusion and interior face of curtain wall glass.

    a. Thickness: Standard ½ inch (12.7 mm) or 1 inch (25.4mm) to accommodate a larger mullion deflection.
    b. Color:Charcoal.
4. Fasteners: Self tapping or appropriate threaded fastener.
5. Snap Cover: Snap on fastener cover.
6. Finish: Manufacturer's standard clear anodized.

G. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

H. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

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, except floors. 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. 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 C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. 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: Vertical surfaces unless otherwise indicated.
2. Type X: Where required for fire-resistance-rated assembly.
3. Ceiling Type: Ceiling surfaces.
4. Moisture- and Mold-Resistant Type: All vertical surfaces unless noted otherwise.
5. Type C: Where required for specific fire-resistance-rated assembly indicated.

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 vertically (parallel 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-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-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.

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 recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.4 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 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 unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.
4. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints**,** rounded or beveled edges**,** and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. 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.

3.6 ACOUSTIC MULLION TRIM INSTALLATION

A. Measure and cut sound barrier wall end cap to proper lengths.

B. Notch around horizontal mullions, sills, or other obstructions leaving appropriate gap for differential movement between the sound barrier wall end cap and the obstruction.

C. Apply continuous bead of acoustical sealant to the acoustical foam surface that will be in contact with the drywall edge.

D. Place sound barrier wall end cap on the vertical surface of the drywall partition wall and loosely install fasteners in the top and bottom slotted holes of the wall end cap.

E. Plumb the wall end cap leaving recommended gap spacing between the interior glass surface and the wall end cap. Foam gasket to be in contact with glass.

F. Tighten top and bottom fasteners to secure end cap.

G. Install additional fasteners at 12 inches on center, minimum.

H. Install snap cover to conceal fasteners.

I. Apply sealant at joints of dissimilar materials as desired.

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 093000 – CERAMIC TILE

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. Ceramic tile.
2. Stone thresholds.
3. Waterproof and crack isolation membrane.
4. Metal edge strips.

B. Related Sections:

1. Section 017419 “Construction Waste Management Plan” for provision of waste management.
2. Section 092900 "Gypsum Board" for moisture and mold resistant gypsum board.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.60 wet.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 5 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 5 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile from one source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one 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 a single manufacturer for each product:

1. Stone thresholds.
2. Waterproof and crack isolation membrane.
3. Metal edge strips.

1.8 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 requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has 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.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. FloorScore Compliance: Tile for floors shall comply with requirements o FloorScore Standard.

2.2 TILE PRODUCTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide ceramic tile materials by the manufacturers listed below for each specific tile type.

B. Ceramic Wall Tile Type 1 (CT1):

1. Manufacturer: American Olean Horizon; glazed ceramic.
2. Size: 6” x 16”.
3. Color: As selected by Architect from full range of available colors. Architect reserves the righ to select, allocate and vary colors throught the building including floor patterns which will be determined by the Architect at a future time.

C. Floor Tile:

1. Tile: Crossville, Color Blox 2.0
2. Size: 12”x12” with 3”X3” Mosaic
3. Color: As selected by Architect from full range of available colors. Architect reserves the right to select, allocate and vary colors and patterns throughout the building including floor patterns which will be determined by the Architect at a future time.

D. Wall Base:

1. Tile: Daltile, Color Wheel Classic
2. Size: 6” x 6” inch Cove Base, CUT HEIGHT AS REQUIRED
3. Color: As selected by Architect from full line.

2.3 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

B. Slate Thresholds: ASTM C 629, Classification II Interior, with fine, even grain and honed finish.

1. Description: Uniform, black stone.

2.4 WATERPROOF AND CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and ANSI A118.12 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hydro Ban as manufactured by Laticrete International or comparable product by one of the following:

a. Bonsal American; an Oldcastle company.
b. Bostik, Inc.
c. MAPEI Corporation.
d. Southern Grouts & Mortars, Inc.
e. TEC; a subsidiary of H. B. Fuller Company.

2.5 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

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. Bonsal American; an Oldcastle company.
b. Bostik, Inc.
c. Laticrete International, Inc.
d. MAPEI Corporation.
e. Southern Grouts & Mortars, Inc.
f. Summitville Tiles, Inc.
g. TEC; a subsidiary of H. B. Fuller Company.

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

B. Organic Adhesive: ANSI A136.1, Type I.

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. Bonsal American; an Oldcastle company.
b. Bostik, Inc.
c. Laticrete International, Inc.
d. MAPEI Corporation.
e. Southern Grouts & Mortars, Inc.
f. Summitville Tiles, Inc.
g. TEC; a subsidiary of H. B. Fuller Company.

2.6 GROUT MATERIALS

A. Polymer-Modified Tile Grout: ANSI A118.7.

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. Bonsal American; an Oldcastle company.
    b. Bostik, Inc.
    c. Laticrete International, Inc.
    d. MAPEI Corporation.
    e. Southern Grouts & Mortars, Inc.
    f. Summitville Tiles, Inc.
    g. TEC; a subsidiary of H. B. Fuller Company.

2.7 MISCELLANEOUS MATERIALS

A. Metal Edge Strips:

1. Basis-of-Design Product: Subject to compliance with requirements, provide metal edge strips as manufactured by Schluter.
2. Style: Rondec-DB.
3. Finish: Satin anodized aluminum (AE).
4. Accessories: 90 degree outside corner.

B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

C. 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.

D. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

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. Bonsal American; an Oldcastle company; Grout Sealer.
    b. Bostik, Inc.; CeramaSeal Siloxane 220.
    c. MAPEI Corporation; KER 004, Keraseal Penetrating Sealer for Unglazed Grout and Tile.
    d. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
    e. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
    f. TEC; a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

2.8 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

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.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

3.3 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Joint Widths: Install wall tile with manufacturer's recommended joint widths.

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. Do not extend waterproofing and crack isolation membrane under thresholds set in latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on waterproofing and crack isolation membrane with elastomeric sealant.

J. Grout Sealer: Apply grout sealer to grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 WATERPROOFING AND CRACK ISOLATION MEMBRANE INSTALLATION

A. Install waterproofing to comply with ANSI A108.13, ANSI A108.17 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over waterproofing and crack isolation membrane has cured.

C. Extend membrane up walls to height of base.

3.5 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Tile Installation F122 (Slab on grade and supported slabs): Thin-set mortar on waterproof/crack isolation membrane; TCA F122.

a. Tile Type: CT1.
b. Thin-Set Mortar: Latex- portland cement mortar.
c. Grout: Polymer-modified sanded grout.

B. Interior Wall Installations, Metal Studs or Furring:

1. Tile Installation W223: Organic adhesive on solid backing; TCA W223.

a. Tile Types: CT1, CT2, CT3.
b. Grout: Polymer-modified unsanded grout.

END OF SECTION 093000

SECTION 095123 - ACOUSTIC TILE CEILINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes

1. Acoustical ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

B. Related Sections

1. Section 09 20 00 - Gypsum Board
2. Section 01 81 13 - Sustainable Design Requirements
3. Section 01 81 19 - Indoor Air Quality Requirements
4. Division 23 - HVAC Air Distribution
5. Division 26 - Electrical

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
3. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
4. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
5. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
6. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
8. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint

9. ASTM E 1264 Classification for Acoustical Ceiling Products

B. International Building Code

C. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

1.4 SYSTEM DESCRIPTION

A. Continuous/Wall-to-wall

B. Discontinuous

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.

B. Samples: Minimum 6-inch x 6-inch samples of specified acoustical panel; 8-inch-long samples of exposed wall molding and suspension system, including main runner and 4-foot cross tees.

C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with or supported by the ceilings.

1.6 SUSTAINABLE MATERIALS

A. Transparency: Manufacturers will be given preference when they provide documentation to support sustainable requirements for the following: Material ingredient transparency, Removal of Red List Ingredients per LBCV3, Life Cycle impact information, Low-Emitting Materials, and Clean Air performance.

1. Low Emitting products with VOC emissions data. Preference will be given to manufacturers that can provide emissions data showing their products meet any of the following: CDPH/EHLB/Standard Method v1.2-2017; Indoor Air Quality Certified to SCS-105 v4.2-2023
2. Life cycle analysis. Products that have communicated lifecycle data through Environmental Product Declarations (EPDs) will be preferred.
3. End of Life Programs/Recycling: Where applicable, manufacturers that provide the option for recycling of their products into new products at end-of-life through take-back programs will be preferred.
4. Products meeting LEED V4 requirements including:
    i. Storage & Collection of Recyclables
    ii. Construction and Demolition Waste Management Planning
    iii. Building Life-Cycle Impact Reduction

1.7 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer to ensure fit and function.

B. Installer Qualifications: Company specializing in performing specified work type, a minimum of three years of documented experience, and approved by the manufacturer.
C. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
D. Surface Burning Characteristics: Tested per ASTM E 84 and complying with ASTM E 1264 Classification.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units 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 ceiling units, permit them to reach room temperature and a stabilized moisture content.
C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.9 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:
    1. Acoustical Panels with HumiGuard® Max and HumiGuard® Plus performance: sagging and warping
    2. Acoustical panels with BioBlock® performance: growth of mold and mildew
    3. Grid System: rusting and manufacturer's defects
B. Warranty Period:
    1. Ceiling System: Thirty (30) years from date of substantial completion

1.10 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
    1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Ceiling Panels:
    1. Armstrong World Industries, Inc.
B. Suspension Systems:
    1. Armstrong World Industries, Inc.

C. Sound Scape Shapes:

1. Armstrong World Industries, Inc.

2.2 ACOUSTICAL CEILING UNITS

A. Acoustical Panel Ceilings

1. Surface Texture: Fine Texture
2. Composition: Mineral Fiber
3. Color: White
4. Size: 24 in x 24 in,
5. Edge Profile:Beveled Tegular, Square Lay-in
6. Noise Reduction Coefficient (NRC) ASTM C 423 Classified w/ UL label on product carton: 0.75.
7. Articulation Class (AC): ASTM E 1111; Classified with UL label on product carton: 170
8. Flame Spread: ASTM E 1264; Class A
9. Light Reflectance (LR) White Panel: ASTM E 1477; 0.85
10. Dimensional Stability: Standard, HumiGuard Plus
11. Recycle Content: Up to 87% total recycled content. (Total recycled content: pre-consumer, post-consumer and post-industrial)
12. Life Cycle Assessment: Third Party Certified Environmental Product Declaration (EPD)
13. Indoor Air Quality Certified to SCS-105 v4.2-2023
14. USDA Certified Biobased Product
15. Basis of Design: ULTIMA Lay in & Tegular, Item - Cirrus” as manufactured by Armstrong World Industries, Inc. or equal.

B. SoundScape Shapes

1. Surface Texture: Fine
2. Composition: Fiberglass
3. Color: White (DWH), Black (DBL), Riverstone (DRV), Stone (DSE), Oat (DOT), Light Grey (DLG), Sandstone (DSS), Boxwood (DBW), Fern (DFN), Ivy (DIV), Ocean (DOC), Twilight (DTT), Rainstorm (DRS), Mist (DMT), Topaz (DTZ) or custom color
4. Shape Design:
   5444F02G01 90° Hexagon
5. Edge Profile: Square
6. Recycled Content: 51%
7. Acoustics: Sound absorption up to 1.00 Noise Reduction Coefficient (NRC) ASTM C 423
8. Flame Spread: ASTM E 1264; Class A (UL)
9. Dimensional Stability: BioBlock; Anti-Microbial, inherent

10. Basis of Design: SoundScapes Shapes, as manufactured by Armstrong World Industries

11. Products shall comply with the Build America, Buy America Act (BABA)

2.3 METAL SUSPENSION SYSTEMS

A. Components: Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.

1. Structural Classification: ASTM C 635 Intermediate or Heavy Duty.
2. Color: White or match the actual color of the selected ceiling tile, unless noted otherwise.
3. Sustainability: Environmental Product Declaration (EPD), Health Product Declaration (HPD)
4. Basis of Design
    i. Prelude XL 15/16” Exposed Tee as manufactured by Armstrong World Industries, Inc. or equal.

B. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

C. Edge Moldings manufactured by Armstrong World Industries, Inc.

D. AXIOM Trim & Transitions as manufactured by Armstrong World Industries, Inc. www.armstrongceilings.com/axiom

E. Accessories as manufactured by Armstrong World Industries, Inc.

2.4 INDIVIDUAL SUSPENSION

1. Attachment to Drywall or solid surface: Acceptable product as manufactured by Armstrong World Industries

    a. Item 5455 – Drywall Hanging Kit (2 per kit) For individual panel attachment to structure.

    b. Item 5588 – Wall Hanging Kit (4 per kit) For individual panel attachment to a wall.

2.4.1 INDIVIDUAL MOUNTING:

Attachment to Drywall or solid surface: Acceptable product as manufactured by Armstrong World Industries

a. Item 5455 – Drywall Hanging Kit (2 per kit) For individual panel attachment to structure.

b. Item 5588 – Wall Hanging Kit (4 per kit) For individual panel attachment to a wall.

2.4.2 GROUP SUSPENSION SYSTEMS:

A. Group Suspension: Acceptable product as manufactured by Armstrong World Industries

a. Item 5451_ _ - Grouping Frame Kit, Black or White (4 per kit). 12’ suspension frames used to group panels together.

b. Item 5452_ _ - Frame Splice Kit, Black or White (2 per kit). Connects group suspension frames for longer runs (> 12 feet).

c. Item 5453D060 – 60º Frame Alignment Kit (4 per kit). For use with group suspension frames.

d. Item 5453D090 – 90º Frame Alignment Kit (4 per kit). For use with group suspension frames.

e. Item 5454_ _ - Panel Hook Kit, Black or White. For use with group frames (one kit per all panels except item 5449, Large Rectangle, which requires two kits).

f. Item 5450L8CR – Deck Hanging Kit (2 per kit). Allows for suspending grouping frames from deck and bottom end adjustment of height at panel or frame level.

B. Accessories (based on selection)
a. Item 5632 – Grid Hook Kit (4 per kit). For hanging individual panels from an Armstrong standard suspension system.
b. Item 5629 – Multi-plane Hanging 1” Drop Hook Kit
c. Item 5630 – Multi-plane Hanging 2” Drop Hook Kit
d. Item 5631 – Multi-plane Hanging 3” Drop Hook Kit

C. Seismic Accessories Required (based on “Seismic Design Category”)

PART 3 – EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.3 INSTALLATION

A. Follow manufacturer installation instructions.

B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.
C. Suspend main beam from overhead construction with hanger wires spaced 4 feet on center along the length of the main runner. Install hanger wires plumb and straight.
D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.
E. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.
F. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.
B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

End of Section 095123

SECTION 096500 - RESILIENT FLOORING

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. Luxury vinyl floor tile.
2. Rubber floor Tile
3. Vinyl base for resilient flooring
4. Vinyl molding accessories.

B. Related Sections:

1. Section 017419 “Construction Waste Management Plan” for provision of waste management.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of floor tile, resilient base and accessories indicated for color selection.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile 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.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
2. Resilient Wall Base and Molding Accessories: Furnish not less than 12 linear feet for every 500 linear feet or fraction thereof, of each type, color and size of resilient product installed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by the 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.

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 in spaces to receive floor tile during the following time 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.

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 OWNER PROVIDED MATERIAL

A. The existing Dance Room floor shall receive new vibration absorbent rolled flooring provided by the owner. The new flooring is stored in the building and shall be installed by this contractor.

PART 2 - PRODUCTS

2.1 LUXURY VINYL COMPOSITION FLOOR TILE

A. TYPE 1 - Basis-of-Design Product: Luxury Vinyl composition floor tile materials indicated below shall be as manufactured by Shaw Contract. Comparable products by alternate manufacturers are acceptable subject to compliance with the quality and performance requirements established by the specified products.

1. Style Name: Terrain II 20 Mil
2. Collection: Terrain II
3. Style Number: 0454V
4. Construction: Commercial Luxury Vinyl Tile
5. Wearing Surface: Smooth

6. Finish: EcoGuard
7. Size: 6 inches by 48 inches (15 cm x 122 cm)
8. Thickness: 0.098 in (2.5 mm)
9. Wear Layer Thickness: 20 mil
10. Edge Profile: Squared Edge

B. TYPE 2 - Basis-of-Design Product: Luxury vinyl floor tile materials shall be as manufactured by Mannington Commercial. Comparable products by alternate manufacturers are acceptable subject to compliance with the quality and performance standards established by the specified Product.

1. Style Name: Primary Elements Collection, Bond & Structure – 20mil
2. Tile Standard: ASTM F1700, Class III, Type B
3. Total Thickness: 0.098 inch (2.5 mm).
4. Wear Layer Thickness: 20 mil
5. Wearing Surface: Enhanced Urethane
6. Size: 12”x24”
7. Architect reserves the right to select, allocate, and vary sizes and patterns throughout the building.

C. Fire-Test-Response Characteristics:

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E648.

D. Colors and Patterns: As selected by Architect from full range of industry colors. Architect reserves the right to select, allocate and vary colors and throughout the building including floor patterns with varied colors which will be determined by the Architect at a future time.

2.2 VINYL BASE (VB)

A. Basis-of-Design Products: Vinyl base materials are based on products manufactured by Johnsonite. Comparable products by alternate manufacturers are acceptable subject to compliance with the quality and performance standards established by the specified products.

B. Vinyl Base: Traditional Vinyl Base.

C. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).

1. Group: I (solid, homogeneous).
2. Style and Location:
   a. Topset Cove: Provide in all areas with resilient flooring and other areas as indicated on the Drawings.

D. Minimum Thickness: 0.125 inch (3.2 mm).

E. Height: 4 inches (102 mm)

F. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.

G. Outside Corners: Job formed or preformed.

H. Inside Corners: Job formed or preformed.

I. Colors and Patterns: As selected by Architect from full range of industry colors. Architects reserve the right to select, allocate and vary colors throughout the building which will be determined by the Architect at a future time.

2.3 VINYL MOLDING ACCESSORIES

A. Manufacturers: Vinyl molding accessories shall from the same manufacturer as resilient base materials.

B. Description: Vinyl carpet edge for glue-down applications, reducer strip for resilient flooring and transition strips.

C. Profile and Dimensions: As required to accommodate thickness of adjacent materials.

D. Colors and Patterns: As selected by Architect from full range of industry colors.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. This Contractor shall be responsible for moving all furniture, refrigerators, desks, tables, chairs, file cabinets etc. in-order to perform the installation of prepping floors and installation of new flooring. The Owner shall be responsible for moving and relocating all computers, wires, loose items on desks etc.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Existing Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum

pickup leaving a bare concrete surface having a minimum profile in accordance with manufacturer's requirements as described by the International Concrete Repair Institute.

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.

2. Repair damaged and deteriorated concrete according to flooring manufacturer's written instructions.
3. Verify that existing concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

   a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement or as required by and acceptable to the manufacturer.

4. Alkalinity and Adhesion Testing: Verify that new and existing concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
5. Provide verification in writing from the manufacturer that the test results for moisture-vapor emissions, alkalinity and adhesion are acceptable to allow installation of the flooring materials.

C. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

   1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

   1. Lay tiles square with room axis unless otherwise shown on the Drawings or as directed by the Architect.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

    a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

    a. Miter or cope corners to minimize open joints.

3.5 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.6 FIELD QUALITY CONTROL

A. Testing: Engage a qualified testing agency to test electrical resistance of static-control resilient flooring for compliance with requirements.

1. Test the flooring with an ohms meter according to EOS/ESD S7.1, ASTM F150 or NFPA 99 (Figure C). All measurements shall be surface to ground.
2. Arrange for testing after static-control adhesives have fully cured and static-control resilient flooring has stabilized to ambient conditions and after ground connections are completed.

3.7 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 099100 - PAINTING

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 surface preparation and the application of paint systems on exterior and interior substrates including but not limited to the following:

1. Concrete.
2. Concrete masonry units (CMUs).
3. Steel and iron.
4. Aluminum (not anodized or otherwise coated).
5. Wood.
6. Fiberglass.
7. Plastic.
8. Gypsum board.
9. Cotton or canvas insulation covering.
10. ASJ insulation covering.

B. Paint all exposed surfaces in all rooms, except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available. Please note that there are spaces in the building without ceilings with exposed structure, ductwork, piping (insulated and non-insulated) and conduit.

1. Painting includes field-painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, wood decks, and primed metal surfaces of mechanical and electrical equipment.
2. Backpriming of all painted/stained woods.

C. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.

1. Prefinished items not to be painted include the following factory-finished components:

a. Acoustic materials
b. Finished mechanical and electrical equipment. Electrical load center panel covers in finished spaces shall be painted as specified herein regardless of factory finish.
c. Light fixtures
d. Metal louvers and brick vents

2. Finished metal surfaces not to be painted include:

a. Anodized aluminum
b. Stainless steel
c. Chromium plate
d. Copper

e. Bronze
f. Brass
g. Galvanized lintels and railings.

3. Operating parts not to be painted include moving parts of operating equipment, such as the following:

a. Valve and damper operators.
b. Linkages.
c. Sensing devices.

C. Related Requirements:

1. Section 017419 "Construction Waste Management" for provisions of waste management.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
3. Section 055100 "Metal Stairs" for shop priming metal pan stairs.
4. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.9 WASTE MANAGEMENT AND DISPOSAL

A. Paint, stain and wood preservative finishes and related materials (thinners, solvents, etc.) are regarded as hazardous products and are subject to regulations for disposal. Obtain information on these controls from applicable Federal, State and Local government departments having jurisdiction.

B. All waste materials shall be separated and recycled. Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility. Materials that cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

C. Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

D. To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground the following procedures shall be strictly adhered to:

1. Retain cleaning water for water-based materials to allow sediments to be filtered out. In no case shall equipment be cleaned using free draining water.
2. Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
3. Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
4. Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.
5. Empty paint cans are to be dry prior to disposal or recycling (where available).
6. Close and seal tightly partly used cans of materials including sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

E. Set aside and protect surplus and uncontaminated finish materials not required by the Owner and deliver or arrange collection for verifiable re-use or re-manufacturing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Paint systems specified in the paint schedules contained at the end of this Section are based on Sherwin-Williams Company products unless noted otherwise. Comparable products by alternate manufacturers are acceptable subject to compliance with the quality and performance standards established by the specified Product. The selection of an alternate manufacturer shall require that all products are obtained from that manufacturer.

B. Claim of unsuitability of a specified product or products to produce a first class finish may not be made by this Contractor unless such claim is submitted to the Architect, in writing, prior to execution of the Contract.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

D. Colors: As selected by Architect from manufacturer's full range.

1. Thirty percent of surface area may be painted with deep tones.
2. Architect reserves the right to select, allocate and vary colors on different surfaces throughout the building.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent.
6. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Aluminum Substrates: Remove loose surface oxidation.

I. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Tanks that do not have factory-applied final finishes.
   h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material..

2. Paint the following work where exposed in occupied spaces:

   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   h. Other items as directed by Architect.

3. The inside of all ductwork behind louvers, grilles and diffusers shall be painted flat black for a minimum distance of 18” or beyond sight lines whichever is greater.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Ferrous Metals - unprimed (including mech. equipment)

Prime Coat:	Sherwin-Williams Pro-Cryl Universal Primer
MPI #107, E3	
1st Finish Coat:	Sherwin-Williams Duration Exterior Acrylic Gloss
MPI #11, E3	
2nd Finish Coat:	Sherwin-Williams Duration Exterior Acrylic Gloss
MPI #11, E3	

B. Ferrous Metals - shop primed (including mech. equipment)

Spot Prime:	Sherwin-Williams Pro-Cryl Universal Primer
MPI #107, E3	
1st Finish Coat:	Sherwin-Williams Duration Exterior Acrylic Gloss
MPI #11, E3	
2nd Finish Coat:	Sherwin-Williams Duration Exterior Acrylic Gloss
MPI #11, E3	

C. CMU (Existing)

1st Finish Coat:	Sherwin-Williams Duration Exterior Acrylic Gloss
MPI #15, E3	

D. Galvanized: Materials are not to be painted.

3.7 INTERIOR PAINTING SCHEDULE

A. Ferrous Metals (At all areas unless noted otherwise on this schedule.)

Prime Coat (Touch-up):	Sherwin-Williams ProMar Zero VOC Interior Latex
MPI #107, E3	Primer
1st Finish Coat:	Sherwin-Williams Emerald Interior Acrylic Latex
MPI #147X-Green, E3	Semi-Gloss
2nd Finish Coat:	Sherwin-Williams Emerald Interior Acrylic Latex
MPI #147X-Green, E3	Semi-Gloss

B. Wood, Opaque Finish

Prime Coat:	Sherwin-Williams ProMar Zero VOC Interior Latex
MPI #149X-Green, E3	Primer
1st Finish Coat:	Sherwin-Williams Emerald Interior Acrylic Latex
MPI #147X-Green, E3	Semi-Gloss
2nd Finish Coat:	Sherwin-Williams Emerald Interior Acrylic Latex
MPI #147X-Green, E3	Semi-Gloss

C. Ductwork

Preparation	Wash with paint manufacturer's recommended product to remove grease and fabrication oils.
Prime Coat: MPI #107, E3	Sherwin-Williams Pro-Cryl Universal Primer
1st Finish Coat: MPI #147X-Green, E3	Sherwin-Williams Emerald Interior Acrylic Latex Semi-Gloss
2nd Finish Coat: MPI #147X-Green, E3	Sherwin-Williams Emerald Interior Acrylic Latex Semi-Gloss

D. Gypsum Drywall (At all areas unless noted otherwise on this schedule).

Prime Coat: MPI #149X-Green, E3	Sherwin-Williams ProMar Zero VOC Interior Latex Primer
1st Finish Coat: MPI #144X-Green, E3	Sherwin-Williams ProMar 200 HP Zero VOC Interior Acrylic Eg-Shel.
2nd Finish Coat: MPI #144X-Green, E3	Sherwin-Williams ProMar 200 HP Zero VOC Interior Acrylic Eg-Shel

E. Exposed Steel Structure (Steel Roof Framing & Metal Deck – Steel Columns are excluded)

Preparation	Clean with paint manufacturer's recommended product to remove grease and fabrication oils.
Prime Coat: MPI #107, E3	Sherwin-Williams Pro-Cryl Universal Primer
1st Finish Coat: MPI #226, E1	Sherwin-Williams Waterborne Acrylic Dryfall Flat
2nd Finish Coat: MPI #226, E1	Sherwin-Williams Waterborne Acrylic Dryfall Flat

F. CMU (New)

Block Filler: MPI #4X, E3	Sherwin-Williams Pro Industrial Heavy Duty Block Filler
1st Finish Coat: MPI #145X, E3	Sherwin-Williams ProMar 200 HP Zero VOC Interior Acrylic Eg-Shel.
2nd Finish Coat: MPI #145X, E3	Sherwin-Williams ProMar 200 HP Zero VOC Interior Acrylic Eg-Shel

G. CMU (Existing)

1st Finish Coat: MPI #145X, E3	Sherwin-Williams ProMar 200 HP Zero VOC Interior Acrylic Eg-Shel.

END OF SECTION 099100

SECTION 10 14 00 - SIGNAGE

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 includes the following:

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1. Interior Panel signs.

B. Related Sections include the following:
1. Section 220000 "Plumbing" for Plumbing Piping and Equipment for labels, tags, and nameplates for plumbing systems and equipment.
2. Section 230000 "Heating Ventilating and Air Conditioning" for labels, tags, and nameplates for HVAC systems and equipment.
3. Section 260000 "Electrical" for labels, tags, and nameplates for electrical equipment.

1.3 DEFINITIONS

A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines", and 521 CMR Massachusetts Architectural Access Board Regulations.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for signs.

1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.

C. Samples for Initial Selection: Manufacturer's plastic color chips consisting of actual units or sections of units showing the full range of colors available for selection.

D. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
1. Dimensional Characters: Full-size Samples of each type of dimensional character, letter, number, graphic element and method of attachment.

E. Sign Schedule: Provide a sign type for each entrance / exit door location for each individual room or stair located within the building.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Fabricator Qualifications: Shop that 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.

C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.

D. Regulatory Requirements: Comply with all applicable federal, state and municipal codes, laws and regulations regarding signage for exits and handicapped barriers.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

A. Coordinate placement of anchorage devices with templates for installing signs.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which 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 embedded graphic image colors and sign lamination.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL SIGNS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Best Manufacturing Sign Systems; HC 300 ADA System or a comparable product by one of the following:

2. ASI-Modulex, Inc.
3. Gemini Incorporated.
4. Mohawk Sign Systems.
5. Approved Equal.

B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner, complying with the following requirements:

1. Melamine Plastic Laminated on Phenolic Core: Solid phenolic panel core with graphic image covered with thermosetting resin face layer ¼" thick, with background painted a contrasting color and rated non-static fire retardant and self-extinguishing, with raised graphics and Grade 2 Braille 1/32 inch (0.8 mm) above surface with contrasting colors as selected by Architect from manufacturer's full range.
2. Edge Condition: Bullnose.
3. Corner Condition: Rounded to ½" radius.
4. Mounting: Framed.
    a. Wall mounted with concealed anchors and two-face tape.
    b. Manufacturer's standard anchors for substrates encountered.
5. Custom Paint Colors: Match Pantone color matching system.
6. Color: As selected by Architect from manufacturer's full range.
7. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch (0.8 mm) above surface with contrasting colors.
8. Surface Finish: Mat.

C. Panel Sign Frames:

1. PVC Frames: Extruded, high-impact PVC plastic.
    a. Color: As selected by Architect from manufacturer's full range.
    b. Depth: As required to receive specified panel thickness indicated above.
    c. Profile: Rounded.
    d. Corner Condition: Rounded to radius to receive panel indicated.
    e. Mounting: As indicated below.
        1) Wall mounted with concealed anchors and two-face tape.
        2) Manufacturer's standard anchors for substrates encountered.

D. Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of slide-in inserts and transparent covers with paper inserts printed by Owner.

1. Furnish insert material and software for creating text and symbols for PC-Windows or Macintosh computers for Owner production of paper inserts.
2. Furnish insert material cut-to-size for changeable message insert.

E. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.

1. Panel Material: Clear acrylic sheet with opaque color coating, subsurface applied.
2. Raised-Copy Thickness: Not less than 1/32 inch (0.8 mm).

2.2 ACCESSORIES

A. Anchors and Inserts: Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work. Provide double sided tape at all glass mounting locations

B. Blank Panels: Provide solid color blank covers with double sided tape located on opposite side of signs scheduled for installation on glass surfaces.

2.3 FABRICATION

A. General: Provide manufacturer's standard signs of configurations indicated.

1. Mill joints to tight, hairline fit.
2. Preassemble signs in the shop to greatest extent possible.

2.4 FINISHES, GENERAL

A. 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.

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 work.

B. Verify that items, including anchor inserts, are sized and located to accommodate signs.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.

B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.

1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
2. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
3. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 10 14 00

SECTION 102800 - TOILET AND BATH ACCESSORIES

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 the following:

1. First Floor Restrooms accessories.

2. Mens and Womens room second floor accessories.

3. Locker Room Bathrooms and Shower Rooms accessories
4. Warm air dryers.

B. Related Sections:

1. Section 017419 “Construction Waste Management Plan” for provision of waste management.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Samples: Provide full size samples of accessory item(s) when requested by Architect.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated on Drawings.
2. Identify products using designations indicated on Drawings.

D. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 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.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19 flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch (0.9-mm) minimum nominal thickness.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

E. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

2.2 TOILET AND BATH ACCESSORIES

A. Basis-of-Design Product: Toilet and bath accessories shall be as manufactured by Bradley Corporation, unless noted otherwise. Comparable products by the manufacturer's listed below are acceptable subject to compliance with the quality and performance standards established by the specified products.

1. Bobrick Washroom Equipment.
2. American Specialties, Inc.

B. Toilet Tissue (Roll) Dispenser:

1. TTD-1: Black D67023-A, surface mounted LoCor by Solaris Paper

C. Grab Bars: Series 812 with concealed mounting and safety-grip finish

1. GB18: 001-18
2. GB36: 001-36
3. GB42: 001-42

D. Paper Towel Dispenser/Disposal:

1. PTD-1: Black D68006-A, surface mounted LoCor by Solaris Paper

E. Soap Dispensers:
1. SD-1: 6A00-11 surface mounted tank type vertical.
2. SD-2: 6315-KT0000 Starter Kit – counter mounted.

F. Sanitary Napkin Disposal (SND): 4A10-11 surface mounted

2.3 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of four keys to Owner's representative.

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.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104413 – FIRE EXTINGUISHERS AND CABINETS

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 the following:

1. Portable fire extinguishers.
2. Fire extinguisher cabinets.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.

1. Fire Extinguishers: Include rating and classification.
2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, unless otherwise noted, provide products listed below as manufactured by J. L. Industries or comparable products by one of the following:

1. Larsen's Manufacturing Company
2. Potter Roemer
3. Kidde Residential and Commercial Division
4. Amerex

2.2 FIRE EXTINGUISHER SCHEDULE

A. Type FE-1:

1. Cabinet: Cosmopolitan, stainless steel, fully recessed with flat trim, series number 8135, 9" x 18" x 5 ½" with S21 door.
2. Extinguisher: Cosmic 5E – multi-purpose chemical with a 3A-40BC rating.

B. Type FE-2:

1. Extinguisher: Cosmic 10E – multi-purpose chemical with a 4A-60BC rating.
2. Mounting bracket: MB 846A.

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material.

a. Provide factory-drilled mounting holes.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

B. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated below**:**

1. Fire-Protection Cabinets: 54 inches above finished floor to top of cabinet.
2. Mounting Brackets: 48 inches above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

3.3 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.

END OF SECTION 104413

SECTION 12 24 13 - ROLLER WINDOW SHADES

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 sunscreen roller shades.

B. Related Requirements:

1. Division 6 Section "Miscellaneous Rough Carpentry" for wood blocking for mounting roller shades and accessories.

1.3 ACTION SUBMITTALs:

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
3. Storage and handling requirements and recommendations.
4. Mounting details and installation methods.

B. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.

C. Selection Samples: For each finish product specified, one set of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section.

B. Installer Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.

C. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

D. Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644,ATCC9645.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver shades in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 WARRANTY

A. Manufacturer's standard written limited warranty of not less than 10 years interior.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Roller shades shall be as manufactured by Phifer SheerWeave and Dual Shade Systems. Comparable products by alternate manufacturers are acceptable subject to compliance with the quality and performance standards established by the specified products.

1. Manual operating, chain drive, sunscreen roller shades at windows indicated on drawings.

2.2 CLUTCH BRAKE MANUAL SHADE SYSTEM

A. General: Clutch roller shades shall be a ball chain-operated system utilizing a bidirectional wrap spring clutch. System shall be capable of smoothly raising and lowering the shade to any desired height and maintaining that position without slippage. The shade shall not be operable fy any other means other than the chain. Pulling on the hem bar will not disengage the clutch. The system will provide a maximum fabric gap of 0.75" per side.

B. Clutch and Tube: System shall incorporate a bi-directional wrap spring clutch that does not require adjustment. Shades shall stop upon release of clutch. Clutch may be mounted on either end of roller tube and fabric may be forward or reverse reolled. Manufacturer shall identify appropriate shade tube and clutch size based on shade size, fabric type and application requirements.

C. Clutch Control Loop: Chain shall be #10 stainless steel 90 pound test ball chain. Chain shall be provided with connector and upper and lower ball stops.

D. Clutch Idle End Cap: Two-piece unit consisting of an outside sleeve and center bearing shaft made of high strength fiberglass reinforced polyester.

E. Clutch Mounting Brackets: Brackets shall be manufacturer's standard for mounting inside, outside or to the ceiling with the clutch on either end.

F. Lift Assist Spring: Manufacturer shall provide a lift assist spring to prevent excessive deflection along the length of the tube as necessary dependent upon the shade weight and size.

G. Lift Assist Spring Mounting Brackets: Manufacturer's standard for universal mounting position with locking device that provides safe retention of the spring end in its bracket.

2.3 SHADE CLOTH

1. Sheerweave Style # 2410 & Sheerweave Style # 7100 Blackout - opaque. 37% Fiberglass, 63% vinyl on Fiberglass; meeting the requirements of NFPA 701.
   a. Light Filtering: 3% open
   b. Dual Shade System – Blackout & Light Filtering.

2. Colors: To be selected by Architect from manufacturer's full range of colors and patterns.

2.4 ACCESSSORIES

A. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

1. Shape: L-shaped. Manufacturer's standard height.

B. Bottom Treatment: Manufacturer's standard hem bar of extruded aluminum bar enclosed in a thermally-sealed pocket across the bottom of the shading fabric.

2.5 FABRICATION

A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.

B. Fabricate shadecloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design.

C. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shadebands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the shadecloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.

D. For railroaded shadebands, provide seams in railroaded multi-width shadebands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer's standards. In absence of such standards, assure proper use of seams or battens as required to, and assure the proper tracking of the railroaded multi-width shadebands.

E. Provide battens for railroaded shades when width-to-height (W:H) ratios meet or exceed manufacturer's standards. In absence of manufacturer's standards, be responsible for proper use and placement of battens to assure proper tracking and roll of shadebands.

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.

C. Clean surfaces thoroughly prior to installation.

D. Prepare surfaces using th methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.2 INSTALLATION

A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow proper clearances for window operation hardware.

B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

C. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

D. Engage Installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

3.3 ADJUSTING

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 12 24 13

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SECTION 21 00 00 – FIRE PROTECTION

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS AND REFERENCES

A. Include “General Requirements” and applicable parts of Division 1 as part of this section.

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. Where paragraphs of this section conflict with similar paragraphs of Division 1, requirements of this section shall prevail.

C. Coordinate work with that of all other trades affecting, or affected by work of this section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. The Subcontractor shall be responsible for filing all documents, payment of all fees, and securing of all inspections and approvals necessary for the work of this section.

E. The Fire Protection Subcontractor shall carry in the Bid Price all Utility Company and Municipal back charges for all materials furnished and work performed by them in conjunction with this Contract and pay same to the respective agency upon demand. The Fire Protection Subcontractor shall not be entitled to additional compensation after the submittal of his bid price should he fail, for any reason, to obtain the total back charge costs to be incurred by the local utility companies or municipal agencies.

1.2 DEFINITIONS

A. As used in this section, “provide,” means “furnish and install”, and “POS” means “Provided Under Other Sections”.

B. As used in the Contract Drawings and Specifications for Fire Protection work, certain non-technical words shall be understood to have specific meanings as follows, regardless of indications to the contrary in the General Conditions of other documents governing the Fire Protection work.

1. “Furnish” means: Purchase and deliver to the project site complete with every necessary appurtenance and support all as part of the Fire Protection work. Purchasing shall include payment of all sales taxes and other surcharges as may be required to assure that purchased item(s) are free of all liens, claims, or encumbrances.

2. “Install” means: Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the Fire Protection work.

3. “Provide” means: “Furnish” and “Install”.

4. “New” means: Manufactured within the past two (2) years and never before used.

C. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any fire protection item in the Contract Drawings or Specifications for Fire Protection work carries with it the instruction to furnish, install and connect the item as part of the Fire Protection work, regardless of whether or not this instruction is explicitly stated.

D. It shall be understood that the Specifications and Drawings for Fire Protection work are complimentary and are to be taken together for a complete interpretation of the Fire Protection work.

1.3 SCOPE

A. Perform work and provide material and equipment as shown on Contract 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 a complete and fully functional installation.

1. Wet pipe sprinkler system and all components.
2. Sprinkler heads, piping, fittings, hangers and valves.
3. Gate valves, check valves, drain valves, fire department valves.
4. Preparation of complete and detailed Shop Drawings in accordance with NFPA No. 13.
5. Preparation of complete and detailed Working Plans.
6. Submitting Drawings and obtaining necessary approvals, permits and certificates.
7. Tests.
8. Securing hydrant flow test data reports.
9. Hydraulic calculations.
10. Miscellaneous steel support.
11. Assisting the Owner in preparing a fire protection impairment plan.

B. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

C. Give notices, file plans, obtain permits and licenses, pay fees and back charges, and obtain necessary approvals from Authorities Having Jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

D. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this Section. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observer.

E. Before starting work in a particular area of the project, visit site and examine conditions under which work must be performed including preparatory work done under other Sections or Contracts or by Owner. Report conditions that might affect work adversely in writing through Contractor to Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing and preparatory work.

1.4 RELATED WORK UNDER OTHER SECTIONS

A. The following items are not included in this section and will be performed under the designated sections.

1. Temporary Facilities.
2. Earthwork: Excavation and backfill.
3. Concrete:
    a. Equipment foundations.
    b. Housekeeping pads.
    c. Rebar for items “a, and b” above.
4. Masonry: All openings in masonry walls.

5. Waterproofing, Dampproofing and Caulking.
6. Roofing and Flashing.
7. Painting: All painting.
8. Finished Carpentry and Millwork.
9. Steel Doors and Frames.
10. Finished Hardware.
11. Electrical.
12. Plumbing.
13. HVAC.
14. Electric power wiring for all equipment.
15. Fire alarm system and controls.
16. Installation of access panels.
17. Concrete basins and pits.

1.5 REGULATORY REQUIREMENTS

A. Comply with all applicable Federal and State laws, and all Local Codes, By-laws and Ordinances.

B. Where provisions of the Contract Documents conflict with any codes, rules or regulations, the latter shall govern. Where the contract requirements are in excess of applicable codes, rules or regulations, the contract provisions shall govern unless the Architect rules otherwise.

C. Request inspections from Authorities Having Jurisdiction, and obtain all permits and pay for all fees and inspection certificates as applicable and/or required. All permits and certificates shall be turned over to the Owners at the completion of the work. Copies of Permits shall be given to the Resident Engineer prior to the start of work.

D. Unless otherwise specified or indicated, materials and workmanship and equipment performance shall conform with the adapted by the State edition of the following standards, codes, Specifications, requirements and regulations:

1. State Building Code.
2. National Electric Code (NEC).
3. Environmental Protection Agency (EPA).
4. Department of Environmental Protection (DEP).
5. Local Ordinances, Regulations of the City of Providence, Rhode Island.
6. National Fire Protection Association (NFPA).
7. Owner’s Insurance Underwriters.
8. American National Standards Institute (ANSI).
9. American Society of Mechanical Engineers (ASME).
10. American Society of Testing and Materials (ASTM).
11. American Welding Society (AWS).
12. Commercial Standards, U.S. Department of Commerce (CS).
13. Factory Mutual (FM).

14. Industrial Risk Insurers (IRI).
15. National Electrical Manufacturers Association (NEMA).
16. American Gas Association (AGA).
17. Underwriter's Laboratories, Inc. (UL).
18. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
19. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS).
20. Americans with Disabilities Act (ADA).

E. All Fire Protection work shall meet or exceed any other State and Local Codes and/or Authorities Having Jurisdiction including all other standards indicated herein.

1.6 SUBMITTALS

A. This paragraph shall supplement Division 1.

B. Definitions:

1. Shop Drawings: Scaled detailed working Drawings (system layout) and equipment Specifications (cut sheets) indicating all information in accordance with requirements of the applicable NFPA Standards for the specific fire protection systems to be installed in accordance with the Registered Professional Engineer's plans and Specifications.
2. Coordination Drawings: Detailed, large-scale layout Shop Drawings showing HVAC, Electrical, Plumbing and Fire Protection work superimposed to identify conflicts and ensure inter-coordination of Mechanical, Electrical, Architectural, Structural and other work.

C. Submittals, Procedures and Format:

1. Review submittal packages for compliance with Contract Documents and then submit to Architect for review. Submit transparency and two (2) blue or black-line reproductions of each Shop Drawing larger than 8-1/2" x 11". Submit eight (8) sets of each smaller shop drawing. After review, transparency original of each large Shop Drawing and six (6) sets of each small shop drawing will be returned with reviewer's marks. Electronically submitted shop drawings are acceptable.
2. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:
    a. Title.
    b. Name and location of project.
    c. Names of Architect, Engineer, Contractor and Subcontractor(s).
    d. Names of Manufacturer, Supplier, Vendor, etc.
    e. Date of submittal.
    f. Whether original submittal or resubmitted.
    g. Contractors' license number and expiration date.
3. Shop Drawings showing manufacturer's product data shall contain detailed dimensional Drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data alone is not acceptable), electrical requirements and wiring diagrams.

D. Acceptable Manufacturers:

1. The Fire Protection design for this project is based on the single manufacturer listed in the

specification, schedule or shown on the Contract Drawings. In these Specifications certain "Alternate Manufacturers" are listed 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.

b. Have identical operating characteristics to those called for in the Specifications.

c. Fit within the available space it was designed for, including space for maintenance and component removal, with no modifications to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the Contract Documents. The fact that a manufacturer's name appears as acceptable shall not be taken to mean the Architect has determined that the manufacturer's products will fit within the available space. This determination is solely the responsibility of the Contractor.

d. For equipment mounted in areas where structural matters are a consideration, the products must have a weight no greater than the product listed in the schedules or Specifications.

e. Products must adhere to all architectural considerations including, but not limited to, being the same size and of the same physical appearance as scheduled or specified products.

E. Substitutions: Substitution of products by Manufacturers other than those listed shall only be done in accordance with subparagraph "F" "Substitutions and Deviations".

F. Substitutions and Deviations:

1. Deviations from the Contract Documents and the substitution of materials or equipment relative to the "Acceptable Manufacturers" (referred to above) 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 substitution or deviation to the attention of the Architect. The letter shall describe changes in the system shown and physical characteristics (connections to adjacent materials, electrical services, service access requirements, and other characteristics), and differences in operating characteristics.

2. Without letters flagging the substitution or deviation to the Architect, it is possible that the Architect may not notice such substitution or deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Architect, the Contractor shall hold the Architect and his consultants harmless for any and all adverse consequences resulting from the deviations being implemented. Adverse consequences shall include, but not be limited to, excessive noise, excessive maintenance, shortened longevity, spatial coordination problems, and inadequate performance versus scheduled design. This shall apply regardless of whether the Architect has reviewed or approved Shop Drawings containing the deviation, and will be strictly enforced.

3. Do not request substitute materials or equipment unless identical material or equipment has been operated successfully for at least three (3) consecutive years. Such materials and equipment shall be a regular cataloged item shown in the current catalog of the manufacturer. When deviation or substitution is permitted, coordinate fully with related changes to Architectural, Structural, Plumbing, Fire Protection, Mechanical, and other work. Ensure that related changes necessary for coordination of substituted items are made within the Contract Price. Assume full responsibility for safety, operation and performance of the altered system.

4. Substitutions of equipment, systems, etc. requiring approval of local Authorities must comply with such regulations and be filed by the Contractor (should filing be necessary).

5. Consideration will not be given to claims that the substituted item meets the performance

requirements with lesser construction. Performance, as delineated in schedules and in the Specifications, shall be interpreted as minimum performance.

6. Approval of proposed deviations or substitutions, if any, will be made at discretion of Architect.

7. If equipment is proposed for substitution that is not tested and rated according to industry-wide standards, the Architect shall have the right to have performance tests completed, at the Contractor's expense, to confirm the manufacturer's performance claims.

G. Submittal Notations: Submittals will be returned from the Architect marked as illustrated below:

□ NO EXCEPTION TAKEN	□ ACCEPTED AS NOTED
□ NOT ACCEPTED	□ REVISE AND RESUBMIT

1. Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the Contract Drawings and Specifications. Contractor is responsible for dimensions which shall be confirmed and correlated at the job site; fabrication process and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.

H. Schedule: Incorporated the Shop Drawing review period into the construction schedule so that work is not delayed. Contractor shall assume full responsibility for delays caused by not incorporating the following Shop Drawing review time requirements into his project schedule. Allow at least ten (10) working days, exclusive of transmittal time, for review each time shop a Shop Drawing is submitted or resubmitted with the exception that fifteen (15) working days, exclusive of transmittal time, are required for the following:

1. Coordination Drawings, if required by this Specification.

2. If more than five (5) Shop Drawings of this trade are received in one (1) calendar week.

I. List of Proposed Equipment and Materials: Within four (4) weeks after Award of Contract and before ordering materials or equipment, submit a complete list of proposed materials and equipment and indicate manufacturer's names and addresses. No consideration will be given to partial lists submitted out of sequence.

J. Responsibility:

1. The intent of submittal review is to check for capacity, rating, and certain construction features. Contractor shall ensure that work meets requirements of the 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 submittals marked "REVIEWED" to extent that they agree with the 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 the Contract Documents. The Architect's noting of some errors while overlooking others will not excuse the Contractor for proceeding in error. Contract Document requirements are not limited, waived, nor superseded in any way by review.

2. Inform Subcontractors, Manufacturers, Suppliers, etc., of scope and limited nature of review process and enforce compliance with the Contract Documents.

K. Material and equipment requiring Shop Drawing Submittals shall include but not be limited to:

1. Wet pipe sprinkler system components including alarm valves, pipe, fittings, sprinkler heads,

pressure gauges, etc.

2. Sprinkler heads, pipe, fittings, hangers and valves.
3. Valves including gate, fire department, drain and test type.
4. Access panels.
5. Sprinklers shall be referred to on Contract Drawings and shall be specifically identified by the listed manufacturer's style or series designation. Trade names and abbreviations are not permitted.

1.7 SURVEYS AND MEASUREMENTS

A. Base all required measurements, both horizontal and vertical, on reference points established by the General Contractor and be responsible for the correct laying out of the Fire Protection work. In the event of a discrepancy between actual measurements and those indicated, notify the General Contractor in writing. Do not proceed with the work required until written instructions have been issued by the General Contractor.

1.8 COORDINATION

A. Fire Protection Subcontractor shall furnish and install various electrical items relating to the fire protection equipment and control apparatus. The Electrical Subcontractor shall be required to connect power wiring to this equipment unless noted otherwise.

B. The Fire Protection and Electrical Subcontractors shall coordinate their respective portions of the work, as well as the electrical characteristics of the fire protection equipment.

C. All power wiring and local disconnect switches will be provided by the Electrical Subcontractor for the line voltage power.

D. 120V and above power wiring sources extended and connected to fire protection control panels, transformers and switches shall be the responsibility of the Electrical Subcontractor.

E. Flow and tamper switches shall be connected to the Building's fire alarm system by the Electrical Subcontractor.

1.9 INSTALLATION REQUIREMENTS

A. The arrangement of all Fire Protection work shown on the Contract Drawings is diagrammatic only and indicates the minimum requirements of the work. Conditions at the building including actual measurements shall determine the details of the installation. All work shall be laid out and installed so as to require the least amount of cutting and patching.

B. Check the Architectural plans and Specifications before ordering any material and equipment. Any discrepancies shall be brought to the attention of the Architect for his determination prior to proceeding with the work.

1.10 TYPICAL DETAILS

A. Typical details where shown on the Contract Drawings shall apply to each and every item of the project where such items are applicable. They are not repeated in full on the Contract Drawings, which in many cases are diagrammatic only, but with the intention that such details shall be incorporated in full. Any alternate method proposed for use by the Contractor shall have the prior approval of the Architect.

1.11 SLEEVES, INSERTS

A. Furnish and install all sleeves, inserts, anchor bolts and similar items to be set into masonry or concrete, as required for Fire Protection work as indicated in Division 1. Internal diameter of

sleeve shall be 1/2” larger than the outside diameter of the pipe or insulation covered line passing through it.

1.12 FIRESTOPPING, SMOKEPROOFING & WATERPROOFING

A. All cutting, patching, firestopping and waterproofing shall be performed by the Fire Suppression Subcontractor. Refer to Sections 01 73 29 – CUTTING AND PATCHING, 07 00 01 – WATERPROOFING, DAMPPROOFING & CAULKING, and 07 84 13 PENETRATION FIRESTOPPING for project requirements.

1.13 CORING, DRILLING

A. Core, cut and/or drill all holes in walls and floors required for the installation of sleeves and supports for the Fire Protection work.

1.14 ACCESSIBILITY

A. Install all work such that parts requiring periodic inspection, operation, maintenance and repair are readily accessible.

B. Furnish all access panels appropriate to particular conditions, to be installed by trades having responsibility for the construction of actual walls, floors or ceilings at required locations.

1.15 SUPPLEMENTARY SUPPORTING STEEL

A. Provide all supplementary (non-structural) steelwork required for mounting or supporting equipment and materials.

B. Steelwork shall be firmly connected to building construction as required. Locations and methods of attachment shall be approved by the Architect.

C. Steelwork shall be of sufficient strength to allow only minimum deflection in conformity with manufacturer’s published requirements.

D. All supplementary steelwork shall be installed in a neat and workmanlike manner parallel to floor, wall and ceiling construction: all turns shall be made at forty-five and ninety degrees, and/or as dictated by construction and installation conditions.

E. All manufactured steel parts and fittings shall be galvanized.

1.16 TOOLS AND EQUIPMENT

A. Provide all tools and equipment required for the fabrication and installation of the mechanical and electrical equipment at the site.

1.17 PORTABLE AND DETACHABLE PARTS

A. Contractors shall retain in their possession all portable and/or detachable parts and portions of materials, devices, equipment, etc. necessary for the proper operation and maintenance of the Fire Protection system until final completion of the work, at which time they shall be handed over to the Owners.

1.18 RECORD DRAWINGS, PROJECT CLOSEOUT

A. As the work progresses and for the duration of Contract, maintain a complete and separate set of prints of Contract Drawings at job site at all times. Record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to the original design. Work shall be updated on a weekly basis and shall be made available for review by Architect. Failure to perform this work shall be reason for withholding requisition payments. In addition, take photographs of all concealed equipment in gypsum board

ceilings, shafts, and other concealed, inaccessible work. At completion of work, make copies of photographs with written explanation on back. These shall become part of Record Documents.

B. At completion of the work prepare a complete set of electronic Record Drawings showing all systems as actually installed, including all fire alarms and electrical circuitry. The electronic copies will be made available for the Fire Protection Contractor's copying, at his expense, for the Record Drawings. The quantity of electronic copies which are made available shall in no way be interpreted as setting a limit to the number of Drawings necessary to show the required information. The Fire Protection Contractor's professional Draft Person shall transfer changes to electronic copies. Submit sets of prints to Architect for comments as indicated in Division 1 – 01 77 00 – CONTRACT CLOSEOUT.

C. The Architect will not certify the accuracy of the Record Drawings. This is the sole responsibility of the Fire Protection and General Contractors.

D. This trade shall submit the Record Drawings for approval by the Fire and Building Departments in a form acceptable to the departments, when required by the jurisdiction.

E. Record Drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer, make and model numbers of final equipment installation.

1.19 GUARANTEE/WARRANTY

A. Guarantee and 24 hour service.

1. Guarantee Work of this Section in writing for not less than one (1) year following the date of acceptance by the Owner. If the equipment is used for temporary service etc, prior to acceptance by the Owner, the bid price shall include an extended period of warranty covering the one (1) year of occupancy, starting from the date of acceptance by the Owner. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to the Architect's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

2. In addition to guarantee requirements of Division 1 and of Subparagraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.

3. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the warranty period, the affected part or parts shall be replaced by this Contractor without any reimbursement.

4. Replace material and equipment that require excessive service during guarantee period as defined and as directed by Architect.

5. Provide 24 hour service beginning on the date the project is accepted by the Owner, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at no cost to the Owner. Service can be provided by this Contractor or a separate service organization. Choice of service organization shall be subject to Architect and Owner approval. Submit name and a phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

6. Submit copies of equipment and material warranties to Architect before final payment.

7. At end of guarantee period, transfer manufacturer's equipment and material warranties still in force to Owner.

8. This paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.

9. PART 2 paragraphs of this Specification may specify warranty requirements that exceed

those of this paragraph. Those paragraphs shall govern.

10. Use of systems provided under this Section for temporary services and facilities shall not constitute Final Acceptance of Work by Owner, and shall not initiate the guarantee period.
11. Manufacturer's Engineer and Technical Staff on site shall analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction then advise the Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. The Architect and/or Engineer will direct course of action.

1.20 OPERATING, INSTRUCTION AND MAINTENANCE MANUALS

A. Refer to Section 01 70 00 – CONTRACT CLOSEOUT and 01 78 23 – OPERATION AND MAINTENANCE DATA for submittal procedures pertaining to Operating and Maintenance Manuals.

B. Each copy of the approved Operating and Maintenance Manual shall contain copies of approved Shop Drawings, equipment literature, cuts, bulletins, details, equipment and engineering data sheets and typewritten instructions relative to the care and maintenance for the operation of the equipment, all properly indexed. Each Manual shall have the following minimum contents:

1. Table of Contents.
2. Introduction:
    a. Explanation of manual and its purpose and use.
    b. Description of systems.
    c. Safety precautions necessary for equipment.
    d. Illustrations, schematics and diagrams.
    e. Installation drawing.
3. Maintenance:
    a. Maintenance and lubricating instructions.
    b. Replacement charts.
    c. Trouble-shooting charts for equipment components.
    d. Testing instructions for each typical component.
    e. Two (2) typed sets of instructions for ordering spare parts. Each set shall include name, price, telephone number and address of where they may be obtained.
4. Manufacturer's Literature: The equipment for which Shop Drawings have been submitted and approved.

1.21 QUALITY ASSURANCE

A. The requirements of the State Building Code and Local regulations establish the minimum acceptable quality of workmanship and materials, and all work shall conform thereto unless more stringent requirements are indicated or specified herein.

B. All work shall comply with the adapted by the State editions of the codes as referenced herein.

C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

D. Follow manufacturer's directions for articles furnished, in addition to directions shown on Contract Drawings or specified herein.

E. Protect all work, materials, and equipment from damage during process of work. Replace all damaged or defective work, materials and equipment without additional cost to the Owner.

F. All equipment and materials for permanent installation shall be the products of recognized Manufacturers and shall be new.

G. Equipment and materials shall:

1. Where normally subject to Underwriters Laboratory Inc. listing or labeling services, be so listed and labeled.

2. Be without blemish or defect.

3. By products which will meet with the acceptance of all Authorities Having Jurisdiction over the work. Where such acceptance is contingent upon having the products examined, tested and certified by Underwriters or other recognized testing laboratory, the product shall be so examined, tested and certified.

H. All items of equipment or material of one generic type shall be the product of one manufacturer throughout.

I. For items which are to be installed but not purchased as part of the Fire Protection work, the Fire Protection work shall include:

1. The coordination of their delivery.

2. Their unloading from delivery trucks driven into any point on the property line at grade level.

3. Their safe handling and field storage until the time of permanent placement in the project.

4. The correction of any damage, defacement or corrosion to which they may have been subjected. Replacement, if necessary, shall be coordinated with the Contractor who originally purchased the item.

5. Mounting in place, including the purchase and installation of all dunnage, supporting members, and fastenings, necessary to adapt them to architectural and structural conditions.

J. Items which are to be installed but not purchased as part of the Fire Protection work shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the electric work will be considered only if presented in writing within one (1) week of the date of delivery to the project of the items in question. The Fire Protection work includes all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

1.22 DELIVERY, STORAGE AND HANDLING

A. All materials for the work of this section shall be delivered, stored and handled so as to preclude damage of any nature. Manufactured materials shall be delivered and stored in their original containers, plainly marked with the products' and manufacturer's name. Materials in broken containers or in packages showing watermarks or other evidence of damage shall not be used and shall be removed from the site.

1.23 STAGING AND SCAFFOLDING

A. Provide staging and scaffolding for all the work of this section complying with Division 1 requirements.

1.24 EXTRA MATERIALS

A. Furnish extra materials described in following product specification sections that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1.25 PHASING, DEMOLITION AND MAINTAINING EXISTING SERVICES

A. During the execution of the work, required relocation, etc., of existing equipment and systems in the existing building areas where new work is to be installed or new connections are scheduled to be made, shall be performed by the Fire Protection Subcontractor, as required by job conditions and as determined by the Architect in the field, to facilitate the installation of the new system, while demolition, relocation work or new tie ins will be performed. Outages required for construction purposes shall be scheduled for the shortest practical period of time, in coordination with the Owner's designated Representative, for specified, mutually agreeable periods of time, after each of which the interruption shall cease and the service shall be restored. This procedure shall be repeated to suit the Owner's working schedule, as many times as required until all work is completed. Any outages of service shall be approved by the Owner, prior to commencing the work. No outages or shutdowns of service shall occur without the written authorization of the Owner prior to commencing the work. Give notice of any scheduled shutdowns, a minimum of two (2) weeks in advance. Owner shall make their best efforts to meet this request without adversely affecting the fire protection service to the existing building.

B. Prior to any deactivation and relocation or demolition work, consult the Contract Drawings and arrange a conference with the Architect and Owner's Representative in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect all equipment designated to be relocated and reused or to remain in operation and be integrated with the new systems.

C. All deactivation, relocation and temporary tie-ins of fire protection systems and equipment shall be provided by the Fire Protection Subcontractor. All demolition and removal of fire protection systems and equipment designed to be demolished shall be provided by the Fire Protection Subcontractor. Place all demolished fire protection materials except hazardous materials as determined by the Authority Having Jurisdiction in General Contractor's dumpster. All hazardous materials shall be legally disposed of by the Fire Protection Subcontractor.

D. The Owner reserves the right to inspect the material scheduled for removal and salvage any items he deems usable as spare parts.

E. Phasing:

1. The Fire Protection Subcontractor shall construct the subject project in phases as directed by the Architect to suite the project progress schedule, as well as the completion date of the project.

2. For additional information related to phasing, review the General Conditions and Supplementary Conditions and the Architectural Drawings.

1.26 DESIGN CRITERIA

A. Provide wet-pipe sprinklers in all areas. Provide dry-type sprinkler system in all areas where ambient temperature is 40 deg. F or below.

B. Design sprinkler system according to the following:

1. Sprinkler Occupancy Hazard Classifications as follows:

a. Building Services Areas: Ordinary Hazard, Group 2.

b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.

c. General Storage Areas: Ordinary Hazard, Group 2.

d. Mechanical Equipment Rooms: Ordinary Hazard, Group 2.

e. Office and Public Areas: Light Hazard.

2. Minimum Density for Automatic Sprinkler Piping Design – as follows:
   a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
   c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
3. Maximum Protection Area per Sprinkler – as follows:
   a. Office space: 225 sq. ft.
   b. Storage Areas: 130 sq. ft.
   c. Mechanical Equipment Rooms: 130 sq. ft.
   d. Electrical Equipment Rooms: 130 sq. ft.

C. Secure water flow test data taken from fire hydrants nearest site. If recent flow test data is not available from city records, make necessary tests as required by NFPA Standard to determine character of water supply.

D. Run piping horizontally and at right angles to walls and ceilings. Center sprinkler heads with respect to ceiling components, such as ceiling grid, lighting fixtures, HVAC diffusers and speakers, as directed by Architect.

E. Add a 10 psi safety factor to hydraulic calculations for a cushion against future pipe main deterioration. Pipe velocity in sprinkler piping shall not exceed 20 FPS.

F. Provide dry sprinkler system for sprinklers in areas subject to freezing.

G. Provide test connections at highest point of main portion of each sprinkler system, with 1” pipe and valve. Test pipe shall be connected to sprinkler pipe at least 1-1/4” in size and shall discharge outside building.

H. Utilize Victaulic Testmaster 2 for Inspectors test and draining the system.

I. Provide sprinklers in all areas except where exempted by code or AHJ.

1.27 FIRE PROTECTION WORKING PLANS

A. Submit working plans to indicate actual sprinkler system and/or combination system piping layout. Working plans shall be signed and sealed by a Professional Engineer.

B. Seismic restraints: All seismic restraints shall be indicated on working plans including locations and type of plan, details and calculations.

C. Hydraulic calculations shall be signed and sealed by Professional Engineer. Submit working plans and hydraulic calculations to:

1. Architect/Engineer.
2. Insurance Underwriter.
3. Building Department.
4. Fire Department.

D. Submit working plans and hydraulic calculations in one complete package. When it is not possible to submit entire system design in one package due to job conditions, submit plans of entire building indicating areas not yet defined. Submit working plans and hydraulic calculations to:

1. Architect/Engineer.

2. Insurance Underwriter.
3. Building Department.
4. Fire Department.

E. Working plans shall be at least 1/8”=1’ scale of sheets of uniform size. Working plans shall show all data required by NFPA No. 13, including but not limited to:

1. Name of Owner and Occupant.
2. Location, including street address.
3. Point of compass.
4. Full height cross section, or schematic diagram, if required for clarity; including ceiling construction and method of protection for nonmetallic piping.
5. Location of partitions.
6. Location of fire walls.
7. Occupancy class of each area or room.
8. Location and size of concealed spaces, closets, attics, and bathrooms.
9. Any small enclosures in which no sprinklers are to be installed.
10. Size of city main in street and whether dead-end or circulating; and, if dead-end, direction and distance to nearest circulating main. City main test results and system elevation relative to test hydrant.
11. Other sources or water supply, with pressure or elevation.
12. Make, type, and nominal orifice size of sprinklers.
13. Temperature rating and location of high-temperature sprinklers.
14. Total area protected by each system on each floor.
15. Number of sprinklers on each riser per floor.
16. Approximate capacity in gallons of each dry pipe system.
17. Pipe type and schedule of wall thickness.
18. Nominal pipe size and cutting lengths of pipe (or center-to-center dimensions).
    a. Note: Where typical branch lines prevail, it will be necessary to size only one typical line.
19. Location and size of riser nipples.
20. Type of fittings and joints and location of all welds and bends. The Contractor shall specify on Contract Drawing any sections to be shop welded and the type of fittings or formations to be used.
21. Type and locations of hangers, sleeves, braces, and methods of securing sprinklers when applicable.
22. All control valves, check valves, drain pipes, and test connections.
23. Kind and location of alarm bells.
24. Size and location of hose outlets, hand hose, and related equipment.
25. Underground pipe size, length, location, weight, material, point of connection to city main; the type of valves, meters, and valve pits; and the depth that the top of the pipe is laid below grade.

26. Piping provisions for flushing.
27. Where the equipment is to be installed as an addition to an existing system, enough of the existing system indicated on the plans to make all conditions clear.
28. For hydraulic designed systems, the information on the hydraulic data nameplate.
29. A graphic representation of the scale used on all plans.
30. Name and Address of Contractor.
31. Hydraulic reference points shown on the plan shall correspond with comparable reference points on the hydraulic calculation sheets.
32. The minimum rate of water application (density), the design area of water application, in-rack sprinkler demand, and the water required for hose streams both inside and outside.
33. The total quantity of water and the pressure required noted at a common reference point for each system.
34. Relative elevations of sprinklers, junction points, and supply or reference points.
35. If room design method is used, all unprotected wall openings throughout the floor protected.
36. Calculation of loads for sizing, and details of sway bracing.
37. The setting for pressure-reducing valves.
38. Information about backflow preventers (manufacturer, size, type).

F. Working plans will be subject to (Architect's) (Owner's) final approval. Submit to (Architect) (Owner) after review by other Authorities. If necessary to submit plans to Architect before review by other Authorities, identify Authorities that have not reviewed plans and resubmit for final approval when review by all parties is complete.

G. Sprinkler pipe and standpipe pipe sizing shall be based on hydraulic calculations.

H. Fire protection contractor shall provide piping layout on measured Drawings. For renovation projects, this shall require Contractor to field survey existing building and prepare reproducible Drawings on which to show building background and all Fire Protection work.

I. Working Plans shall show all hangers and supports from floors, walls, underside of slabs and structural steel members. Where piping cannot be supported from walls or slabs, contractor shall provide additional structural steel bracing to support pipe.

J. Working Plans shall be submitted with the shop drawing cover sheet from Division 1. Any deviations from original plans and Specifications shall be noted. Any hydraulic deviations shall be noted.

1.28 UNIT PRICES

A. The Fire Protection Subcontractor shall list the following unit prices in bid proposal which shall include the complete installation (labor and materials) for each item(s):

1. Cost for addition of pendent head.
2. Cost for addition of sidewall head.
3. Cost for addition of upright head
4. Savings or deduction for eliminating a sprinkler head.

B. Above prices shall include 10 feet of piping, connection, sprinkler heads, fittings, hangers, labor system draining and refill, drawing involvement and any other associated costs for the addition or deletion of a sprinkler head.

PART 2 – PRODUCTS

2.1 PIPE AND FITTINGS

A. Piping shall meet applicable ANSI or ASTM standard requirements and shall have manufacturer's name and standard marked on each length. Joints shall meet applicable ANSI or ASTM standards requirements. Where ANSI or ASTM standard does not exist, joints and fittings shall bear UL listing symbol.

B. General Material Notes:

1. System components shall be rated for the maximum working pressure to which they are exposed, but not less than 175 psig.
2. Pipe, tube valves and fittings shall meet or exceed ASTM/ANSI standards listed in the National Fire Protection Codes and specifically in NFPA-13.
3. All threaded piping and fittings shall conform to thread cuts listed in ANSI/ASME B1.20.1.
4. Welded methods shall comply with all the requirements listed in American Welding Society document D10.9, Levels AR-3.
5. Provide one-piece chrome plated escutcheons for all wall, floor and ceiling pipe penetrations in finished rooms and areas.

2.2 WET PIPE SPRINKLER AND STANDPIPE (175 psi)

Carbon Steel	2" and Smaller	2-1/2" and Larger
Pipe	Welded and seamless black steel pipe conforming to ASTM A53, ASTM A795 or ANSI/ASTM A135, Schedule 40.	Welded and seamless black steel pipe conforming to ASTM A795 or ANSI/ASTM A135, Schedule 10.
Fittings	Cast iron fittings. ANSI/ASME B16.1 and B16.4	Mechanical grooved couplings with ductile iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts and Vic plug gasket (pre-tube).
Joints	Thread. Apply joint compound or Teflon tape to male pipe threads on threaded systems.	Weld or roll groove. Welding procedures shall conform to the requirements of AWS D.10.9, level AR3.
Flanges	Flanges shall be plain faced and shall be CI-150 and shall conform to ANSI B.16.5.	Flanges shall be plain faced and shall be CI-150 and shall conform to ANSI B16.5.
Gaskets/Bolts	Gaskets shall be full face rubber 1/8" thick. Bolts and nuts shall conform to ANSI B18.2.1 and B18.2.2, respectively.	Gaskets shall be full face rubber 1/8" thick. Bolts and nuts shall conform to ANSI B18.2.1 and B18.2.2, respectively.

A. Notes: Pipe material and fittings shall meet the standards set forth for pipe and tube in the National Fire Code NFPA 13, Section 6.3.

B. Grooved joint couplings shall consist of two (2) ductile iron housing segments, pressure responsive elastomer gasket, and ASTM A449 zinc-electroplated steel bolts and nuts.

1. Rigid: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with NFPA-13. Couplings shall be fully installed at a visual pad-to-pad offset contact. Couplings that require gapping of bolt

pads or specific torque ratings for proper installation are not permitted. Installation-Ready, for direct stab installation without field disassembly. Basis of Design: Victaulic Style 009H and 107N.

2. Flexible: Use in locations where vibration attenuation and stress relief are required. Basis of Design: Victaulic Style 177 Installation-Ready, and Style 77.

2.3 VALVES

A. Valves shall be of materials and weights required by NFPA standards.

B. Valves that control mains inside building shall be approved OS&Y, 175 psi, unless noted otherwise, Basis of Design: Victaulic Series 771. Valves shall be normally open and shall accommodate tamper switches wired under Electrical Section. Victaulic Series 705 grooved end butterfly valves with pressure responsive seat, stainless steel stem (stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating), and weatherproof actuator housing with built-in tamper switches UL/FM approved to 300 psi is acceptable.

C. Check valves shall be approved pattern, 250 psi, installed vertically or horizontally, Victaulic Series 717. Alarm valves shall be 300 psi UL/FM Victaulic Series 751 or approved equal suitable for variable pressure operation and wet pipe system.

D. Valves shall be UL-listed and FM-approved. Valves 2A and smaller shall be bronze body iron sized threaded end, Victaulic style 717, UL/FM approved 250 psi; valves 2-1/2” and larger shall be ductile iron body grooved end, Victaulic Series 705 butterfly valve UL/FM approved at 300 psi. Valves at fire pump shall be iron body butterfly.

2.4 HANGERS, ANCHORS, CLAMPS AND INSERTS

A. Hangers shall meet NFPA Standards. Provide adjustable swivel rings for piping 3” and smaller and adjustable clevis hangers for 4” and larger piping. Support piping from building structure to maintain required grade and pitch of pipe lines, prevent vibration, secure piping in place. Secure hangers to insets where practical. Hanger rods shall have machine threads.

B. Provide vertical brackets and guides for pipe risers at each floor and where horizontal piping is racked along walls. Trapeze hangers may be used where conditions permit.

C. Hanger rods shall be connected to beam clamp, or UL-listed concrete inserts. Beam clamps shall have retaining straps.

D. Hanger spacing shall meet requirements of state and local codes.

E. Pipe supports, vertical and horizontal, shall not bear on sleeves.

F. All support devices shall conform to seismic standards.

G. Provide seismic restraint calculations.

2.5 SPRINKLER HEADS

A. Provide UL-listed and/or FM-approved, (quick response for light hazard) sprinkler heads.

B. Heads shall have ordinary degree temperature ratings, except in areas subject to abnormal heating conditions, where sprinkler heads shall have temperature ratings high enough to prevent accidental discharge. Minimum fusing temperature shall be 155°F.

C. Sprinklers shall be glass bulb type, with hex shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation. (Wrenches shall be provided by the sprinkler manufacturer that directly engage the cast wrench boss). Basis of Design: Victaulic.

D. Sprinkler heads shall be by Victaulic, Tyco, or Reliable.

E. The following table indicates head types:

Sprinkler Head Specifications

Upright Sprinkler	Finish: Temperature Rating: Link: Response Application: Approvals: Equivalent to:	Bronze 155°F (212°F Mechanical Rooms) Glass bulb Standard UL, FM, Local Authority Having Jurisdiction Victaulic V27 or V34
Concealed	Finish: Cover Plate: Temperature Rating: Link: Response Application: Approvals: Equivalent to:	White White 155°F Glass bulb Standard UL, FM, Local Authority Having Jurisdiction Victaulic V38
Pendent/Gasketed	Finish: Cover Plate: Temperature Rating: Link: Response Application Approvals: Equivalent to:	White White with dust tight seal/gasket 155°F Glass bulb Standard UL, FM, Local Authority Having Jurisdiction Victaulic V38
Recess Pendent	Finish: Temperature Rating: Link: Response Application: Approvals: Equivalent to:	White 155°F Glass bulb Standard UL, FM, Local Authority Having Jurisdiction Victaulic V27 or V34
Sidewall	Finish: Cover Plate: Temperature Rating: Link: Orifice Coefficient: Response Application: Approvals: Equivalent to:	White White 155°F Glass bulb 5.6 Standard UL, FM, Local Authority Having Jurisdiction Victaulic V27 or V34 HSW
Quick Response Recessed Pendent	Finish: Temperature Rating: Link: Response Application: Approvals: Equivalent to:	White 155°F - 165°F Glass bulb QR UL listed for 175 psig, FM approved to 175 psig, Local Authority Having Jurisdiction Victaulic V27 or V34 (for light hazards only)

F. Flexible Stainless Steel Sprinkler Drop Systems may be used to locate sprinklers as required by final finished ceiling tiles and walls. The drop shall include a UL approved Series AH2 braided hose with a bend radius to 2-inch to allow for proper installation in confined spaces. The hose shall be listed for [(4) bends at 31” length] [(5) bends at 36” length] [(8) bends at 48” length] [10 bends at 60” length] [(12) bends at 72” length]. Union joints shall be provided for ease of

installation. The flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB1 or AB2 bracket. The bracket shall allow installation before the ceiling tile is in place. The braided drop system is UL listed and FM Approved for sprinkler services to 175 psi (1206 kPa). Basis of Design: Victaulic Vic-Flex.

2.6 SPRINKLER CABINET

A. Provide enameled steel sprinkler cabinet with approved number of sprinkler heads as required by NFPA. Provide appropriate sprinkler wrench with each type of head in each cabinet.

2.7 WATER PRESSURE GAUGES

A. Water pressure gauges of the double spring Bourdon type, as manufactured by U.S. Gauge American, Mueller, Trerice, Ashcroft or approved equal, shall be installed at the top of standpipe risers and at fire pump and alarm check valves. The gauges shall have 3-1/2” diameter face with brass case and shall be Underwriter’s approved.

B. Gauges shall be controlled by a valve with arrangements for drainage. An outlet, at least one quarter of an inch in size, plugged for the installation of the inspector’s gauge shall be located between each valve and gauge.

C. Dial graduations reading in “psig” shall be such that the normal operating pressure of the system installed shall be indicated near the middle of the scale.

D. The accuracy of the gauges shall be within one (1) percent of the scale range.

2.8 SLEEVES AND PENETRATIONS

A. Pipe Sleeve Materials:

1. Sleeves through floors and through exterior, structural and fire-rated construction shall be galvanized Schedule 40 steel pipe.

2. Sleeves through partitions and non-fire-rated construction shall be 26 gauge galvanized steel with lock longitudinal seams or approved plastic pipe.

3. Provide waterproofing membrane locking devices at floors. Provide 150 lb. Slip-on welding flanges at exterior wall penetrations.

B. Fire stop penetration seals in fire-rated construction shall conform to ASTM E814 and shall be ceramic fiber (ProSet Systems Firewall); mineral fiber (Manville Thermo-mat); or silicone foam (Dow RTV 3-6548). Provide mineral fiberboard, matting or putty for damming and forming. Finish seals flush to wall surface and fill gaps with silicone adhesive sealant caulking (Dow 96-081 RTV or approved equal). Provide 1” thick ceramic fiber board on both sides of penetrations in 2 and 3 hour rated walls and floors less than 8” thick. All penetration seals shall be installed in accordance with listing requirements.

C. Packing for sleeves that do not require maintenance of fire rating shall be oakum, silicate, foam, ceramic fiber or mineral fiber with approved sealant. Pack or foam to within one inch of both wall surfaces. Seal penetration packing with approved caulking and paintable waterproof mastic surface finish or silicone caulking.

D. Wall and floor penetration fire stops shall be UL listed, FM approved.

PART 3 – EXECUTION

3.1 COORDINATION

A. Cooperate and coordinate with work of other Sections in executing work of this Section.

B. Verify conditions and take field measurements as required to ensure work shall fit actual

conditions. Field corrections to fabricate work and adjustments to adjacent work where required for proper installation of work shall be subject to Architect's approval. Corrections and adjustments shall be permitted only when not detrimental to appearance and function of work.

3.2 SHUT DOWNS

A. Work with Owner in maintaining integrity of new or existing fire protection system. Coordinate and minimize any and all shut downs of fire protection system as follows:

1. Give proper notice to Owner when making shutdowns, a minimum of two full weeks.
2. Perform all duties required by Owner when making a shut down.
3. Fill out a Shutdown Notice form answering all items requested such as time and location of shut down, systems affected, areas affected, etc. when requesting a shut down.
4. Provide fire watch as required during a shut down.
5. Duration of shut downs shall be kept to a minimum.
6. In no case shall the fire protection system be shut down during off-hours of work day without a fire watch.
7. System shall be returned to normal operating conditions at end of work day.

3.3 TESTS

A. Test sprinkler system as required by NFPA Insurance Underwriters, Factory Mutual and agencies that have jurisdiction.

B. Test water flow detecting devices including associated alarm circuits through inspection test connection.

C. Test sprinkler system under pressure of 200 psi for two hours. Correct defects and leaks. Caulking will not be allowed.

D. Submit written approval of tests from Authorities Having Jurisdiction over installation to Owner before Final Acceptance of work.

E. Submit written approval of tests from Authorities Having Jurisdiction over installation to Owner before Final Acceptance of work.

F. Do not backfill before testing and approval.

G. Notify Architect and various departments and bureaus 48 hours before tests are to be made.

H. Operating test of sufficient duration shall be made for systems, equipment, fixtures and accessories to Owner's satisfaction.

I. General:

1. Test sprinkler and standpipe system and make watertight before painting and concealment. Make partial tests as required, during progress of work. Tests shall be witnessed by: General Contractor, Insurance Underwriter's Representative, Municipal Inspector and a Representative of the Architect.
2. Standpipe and sprinkler system shall be tested to hydrostatic test of 200 psi in accordance with NFPA requirements.
3. If inspection or test show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. Repairs to piping shall be made with new material.

3.4 PIPE VALVE AND EQUIPMENT IDENTIFICATION

A. Provide color-coded pipe identification markers. Pipe markers shall be snap-on laminated plastic

with acrylic coating. Pipe markers shall be applied after painting.

B. Provide arrow marker with each pipe content marker to indicate direction of flow. If flow can be in either direction, use double-headed arrow marker.

C. Mains shall be labeled at points of entrance and exit from mechanical room, next to valves, on risers, at tee fittings, at points of entrance and exit from building, at least once in each room and at intervals not longer than 20 feet.

D. In general, 2" high legend shall be used for pipe lines 4" diameter and larger than ¾" high legend shall be used for pipe lines 3" diameter and smaller.

E. Markers shall be Seton Setmark or approved equal.

F. Color banding shall meet latest ANSI and OSHA requirements.

G. Markers shall have legend with "black" letters:

Service	**Legend**	**Background Color**
Sprinkler	Sprinkler	Red
Combination Sprinkler-standpipe	Sprinkler-Fire	Red

H. Valve Tags:

1. All valves on pipes of every description shall have neat, circular brass valve tags of at least 1.5 inches in diameter, attached with brass hook to each valve stem. Stamp on these valve tags in letter as large as practical, the number of the valve and the service such as "S.P." for sprinkler. The numbers of each service shall be consecutive.

2. All valves on equipment, tanks and pumps shall be numbered by 3 inch diameter red metal discs with white numbers 2 inches high secured to stem of valves by means of brass hooks or small solid link brass chain.

I. Equipment:

1. Nameplates shall be made of black surface, white core laminated "Bakelite" with indented letters.

2. Nameplates shall be a minimum of 3 inches long by 1.5 inches high and bear the equipment name as designated in these Specifications.

3. Equipment identification designations shall be taken from equipment schedules as indicated on the Contract Drawings or specified herein.

3.5 ANCHORS AND INSERTS

A. Inserts shall be UL listed and FM approved and shall be steel of type to receive machine bolt head or nut after installation. Inserts shall permit adjustment of bolt in one horizontal direction and shall develop strength of bolt when installed in properly cured concrete.

B. Provide anchors as necessary for attachment of equipment supports and hangers.

3.6 TYPICAL DETAILS

A. Typical details where shown on the Contract Drawings shall apply to each and every item of the project where such items are applicable. They are not repeated in full on the Control Drawings, which in many cases are diagrammatic only, but with the intention that such details shall be incorporated in full. Any alternate method proposed for use by the Contractor shall have the prior approval of the Owner.

3.7 CORING, DRILLING

A. Core, cut and/or drill all holes in walls and floors required for the installation of sleeves and supports for the Fire Protection work.

3.8 SUPPLEMENTARY SUPPORTING STEEL

A. Provide all supplementary steelwork required for mounting or supporting equipment and materials.

B. Steelwork shall be firmly connected to building construction as required.

C. Steelwork shall be of sufficient strength to allow only minimum deflection in conformity with manufacturer's published requirements.

D. All supplementary steelwork shall be installed in a neat and workmanlike manner parallel to floor, wall and ceiling construction; all turns shall be made at forty-five and ninety degrees, and/or as dictated by construction and installation conditions.

E. All manufactured steel parts and fittings shall be galvanized; manufacturer shall be Unistrut or equivalent.

3.9 SPRINKLER / STANDPIPE INSTALLATION

A. Standpipes shall have pressure gauges at the top and supervised control valves at the bottom.

B. Final sprinkler system test shall be witnessed by Authority Having Jurisdiction, Sales Representative, Owner's Representative and an Insurance Underwriter's Representative. Valves shall be properly adjusted for maximum pressure setting allowable as required and a typewritten report of such tests and adjustments shall be submitted to the Architect.

C. Maintain or install at least one existing or new standpipe riser up through the floors with temporary hose, nozzle and valves, as required for fire protection during construction. Standpipes shall be supplied through a temporary 2-1/2" x 2-1/2"x 4" Siamese inlet at grade located where directed by Fire Department if standpipe is not connected to building fire supply system. Access to temporary Siamese inlet connection shall be kept clear and accessible at all times. Contractor shall ensure temporary fire protection supply availability at all times.

D. Grooved Joints: Install in accordance with the manufacturer's latest published installation instructions. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service. A Factory Trained Representative (direct employee) of the coupling manufacturer shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation. The Representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.

E. Signaling devices shall consist of the following:

1. Electric micro switch locks on zone valves and water flow control switches on each floor supply be wired to fire alarm panel and Building Automation System.

2. Alarm devices provided on alarm valves and pipes by Sprinkler Contractor.

3. Fire alarm zone panels and wiring by Electrical Contractor and System Automation Contractor.

4. Complete coordination shall be exercised between Sprinkler Contractor and Electrical Contractor to ensure electrical connections are compatible with fire alarm system described under Electrical Section.

F. Electric micro switch locks on zone valves and water flow control switches on each floor supply wired to fire alarm panel and Building Automation Sprinkler.

G. Alarm devices provided on alarm valves and pipes by Sprinkler Contractor.

H. Fire alarm zone panels and wiring by Electrical Contractor.

I. Complete coordination exercised between Sprinkler Contractor and Electrical Contractor to ensure electrical connections are compatible with fire alarm system described under Section 26 00 00.

END OF SECTION 21 00 00

SECTION 22 00 00 – PLUMBING TABLE OF CONTENTS

SECTION 22 00 00 – PLUMBING

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS AND REFERENCES

A. Include “General Requirements” and applicable parts of Division 1 as part of this section.

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. Where paragraphs of this section conflict with similar paragraphs of Division 1, requirements of this section shall prevail.

C. Coordinate work with that of all other trades affecting, or affected by work of this section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. The Plumbing Subcontractor shall be responsible for filing all documents, payment of all fees, and securing of all inspections and approvals necessary for the work of this section.

E. The Plumbing Subcontractor shall carry in the Bid Price all Utility Company and Municipal back charges for all materials furnished and work performed by them in conjunction with this Contract and pay same to the respective agency upon demand. The Plumbing Subcontractor shall not be entitled to additional compensation after the submittal of his bid price should he fail, for any reason, to obtain the total back charge costs to be incurred by the local utility companies or municipal agencies.

1.2 DEFINITIONS

A. As used in this section, “provide” means “furnish and install”, and “POS” means “Provided Under Other Sections”.

B. As used in the Contract Drawings and Specifications for Plumbing work, certain non-technical words shall be understood to have specific meanings as follows, regardless of indications to the contrary in the General Conditions of other documents governing the Plumbing work.

1. “Furnish” means: Purchase and deliver to the project site complete with every necessary appurtenance and support, all as part of the Plumbing work. Purchasing shall include payment of all sales taxes and other surcharges as may be required to assure that purchased item(s) are free of all liens, claims, or encumbrances.

2. “Install” means: Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the Plumbing work.

3. “Provide” means: “Furnish” and “Install”.

4. “New” means: Manufactured within the past two (2) years and never before used.

C. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any plumbing item in the Contract Drawings or Specifications for Plumbing work carries with it the instruction to furnish, install and connect the item as part of the Plumbing work, regardless of whether or not this instruction is explicitly stated.

D. It shall be understood that the Specifications and Drawings for Plumbing work are complimentary and are to be taken together for a complete interpretation of the Plumbing work except that indications on the Contract Drawings, which refer to an individual element of work, take precedence over the Specifications where they conflict.

1.3 SCOPE

A. Perform work and provide material and equipment as shown on Contract 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 a complete and fully functional installation.

1. Domestic water piping system.
2. Domestic water heaters.
3. Interior sanitary waste and vent piping system.
4. Plumbing fixtures and trim.
5. Hose bibbs and wall hydrants.
6. Insulation.
7. Valves.
8. Water hammer arresters.
9. Fittings unions, flanges and couplings.
10. Flashing of floor drains.
11. Hangers, plates and inserts.
12. Cleaning, testing and disinfection of piping systems.
13. All supplementary steel for piping and equipment support.
14. Guarantees.
15. Drilling for installation of inserts.
16. Core drilling.
17. Fire seal off all penetrations in floors and walls to the rating of the barrier.
18. Cutting, patching and pipe sleeves.

B. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

C. Give notices, file plans, obtain permits and licenses, pay fees and back charges, and obtain necessary approvals from Authorities Having Jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

D. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this Section. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observer. Site visit is particularly important because this is renovation work.

E. Before starting work in a particular area of the project, visit site and examine conditions under which work must be performed including preparatory work done under other Sections or Contracts or by Owner. Report conditions that might affect work adversely in writing through Contractor to Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing and preparatory work.

1.4 RELATED WORK UNDER OTHER SECTIONS

A. The following items are not included in this section and will be performed under other sections.

1. Temporary Facilities.
2. Earthwork: Excavation and backfill.
3. Concrete:
   a. Equipment foundations.
   b. Housekeeping pads.
4. Masonry: All openings in masonry walls.
5. Waterproofing, Dampproofing and Caulking.
6. Roofing and Flashing.
7. Painting: All painting except as specified herein.
8. Finish Carpentry and Millwork.
9. Steel Doors and Frames.
10. Finish Hardware.
11. Elevators and Lifts.
12. Fire Protection.
13. Electrical.
14. HVAC.
15. Foundation drains.
16. Site drainage.
17. Furnishing of toilet accessories such as toilet paper holders, mirrors and soap dispensers.
18. Utility structures.

1.5 REGULATORY REQUIREMENTS

A. Comply with all applicable Federal and State laws, and all Local codes, By-laws and Ordinances.

B. Where provisions of the Contract Documents conflict with any codes, rules or regulations, the latter shall govern. Where the contract requirements are in excess of applicable codes, rules or regulations, the contract provisions shall govern unless the Architect rules otherwise.

C. Request inspections from Authorities Having Jurisdiction, obtain all permits and pay for all fees and inspection certificates as applicable and/or required. All permits and certificates shall be turned over to the Owners at the completion of the work. Copies of permits shall be given to the resident engineer prior to the start of work.

D. Unless otherwise specified or indicated, materials and workmanship and equipment performance shall conform with the latest edition of the following standards, codes, Specifications, requirements and regulations:

1. Local and State Building, Plumbing, Mechanical, Electrical, Fire and Health Department Codes.
2. American Gas Association (AGA).
3. National Fire Protection Association (NFPA).
4. American Insurance Association (AIA), formerly National Board of Fire Underwriters.
5. Occupational Safety and Health Act (OSHA).
6. Factory Mutual Association (FM).

7. Underwriter's Laboratories (UL).
8. Local Water and Sewer Authorities.
9. State Department of Environmental Protection Regulations.

E. All Plumbing work shall meet or exceed any other state and local codes and/or Authorities Having Jurisdiction including all other standards indicated herein.

1.6 SUBMITTALS

A. This paragraph shall supplement Division 1.

B. Definitions:

1. Shop Drawings: Information prepared by the Contractor to illustrate portions of the work in more detail than shown in the Contract Documents.
2. Coordination Drawings: Detailed, large-scale layout Shop Drawings showing HVAC, Electrical, Plumbing and Fire Protection work superimposed to identify conflicts and ensure inter-coordination of Mechanical, Electrical, Architectural, Structural and other work.

C. Submittals Procedures and Format:

1. Review submittal packages for compliance with Contract Documents and then submit to Architect for review. Submit transparency and two (2) blue or black-line reproductions of each Shop Drawing larger than 8-1/2" x 11". Submit eight (8) sets of each smaller shop drawing. After review, transparency original of each large Shop Drawing and six (6) sets of each small shop drawing will be returned with reviewer's marks. Electronically submitted shop drawings are acceptable.
2. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:
    a. Title.
    b. Name and location of project.
    c. Names of Architect, Engineer, Contractor and Subcontractor(s).
    d. Names of Manufacturer, Supplier, Vendor, etc.
    e. Date of submittal.
    f. Whether original submittal or resubmitted.
3. Shop Drawings showing manufacturer's product data shall contain detailed dimensional Drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data alone is not acceptable), plumbing requirements and wiring diagrams. 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.

D. Acceptable Manufacturers:

1. The Architect's Plumbing design for each project is based on the single manufacturer listed in the schedule or shown on the Contract Drawings. In Division 22 00 00 of these Specifications certain "Alternate Manufacturers" are listed as being acceptable. These are acceptable only if, as a minimum, they:
    a. Accepted by Architect and Engineer.
    b. Meet all performance criteria listed in the schedules and outlined in the Specifications.

c. Have equivalent operating characteristics to those called for in the Specifications.

d. Fit within the available space it was designed for, including space for maintenance and component removal, with no modifications to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the Contract Documents. The fact that a manufacturer's name appears as acceptable shall not be taken to mean the Architect has determined that the manufacturer's products will fit within the available space. This determination is solely the responsibility of the Contractor.

e. For equipment mounted in areas where structural matters are a consideration, the products must have a weight no greater than the product listed in the schedules or Specifications.

f. Products must adhere to all architectural considerations including, but not limited to, being the same size and of the same physical appearance as scheduled or specified products.

E. Substitutions: Substitution of products by manufacturers other than those listed shall only be done in accordance with subparagraph "F" "Substitutions and Deviations".

F. Substitutions and Deviations:

1. Deviations from the Contract Documents and the substitution of materials or equipment relative to the "Acceptable Manufacturers" referred to above, 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 substitution or deviation to the attention of the Architect. The letter shall describe changes in the system shown and physical characteristics (connections to adjacent materials, plumbing services, service access requirements, and other characteristics), and differences in operating characteristics or cycles.

2. Without letters flagging the substitution or deviation to the Architect, it is possible that the Architect may not notice such substitution or deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Architect, the Contractor shall hold the Architect and his consultants harmless for any and all adverse consequences resulting from the deviations being implemented. Adverse consequences shall include, but not be limited to, excessive noise, excessive maintenance, shortened longevity, spatial coordination problems, and inadequate performance versus scheduled design. This shall apply regardless of whether the Architect has reviewed or approved Shop Drawings containing the deviation, and will be strictly enforced.

3. Do not request substitute materials or equipment unless identical material or equipment has been operated successfully for at least three (3) consecutive years. Such materials and equipment shall be a regular cataloged item shown in the current catalog of the manufacturer. When deviation or substitution is permitted, coordinate fully with related changes to Architectural, Structural, Plumbing, Fire Protection, Mechanical, and other work. Ensure that related changes necessary for coordination of substituted items are made within the Contract Price. Assume full responsibility for safety, operation and performance of the altered system.

4. Substitutions of equipment, systems, etc. requiring approval of local Authorities must comply with such regulations and be filed by the Contractor (should filing be necessary).

5. Consideration will not be given to claims that the substituted item meets the performance requirements with lesser construction. Performance, as delineated in schedules and in the Specifications, shall be interpreted as minimum performance.

6. Approval of proposed deviations or substitutions, if any, will be made at discretion of Architect.

7. If equipment is proposed for substitution that is not tested and rated according to industry-wide standards, the Architect shall have the right to have performance tests completed, at the Contractor's expense, to confirm the manufacturer's performance claims.

G. Submittal Notations: Submittals will be returned from the Architect marked as illustrated below:

□ NO EXCEPTION TAKEN	□ ACCEPTED AS NOTED
□ NOT ACCEPTED	□ REVISE AND RESUBMIT

1. Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the Contract Drawings and Specifications. Contractor is responsible for dimensions which shall be confirmed and correlated at the job site; fabrication process and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.

H. Schedule: Incorporated the Shop Drawing review period into the construction schedule so that work is not delayed. Contractor shall assume full responsibility for delays caused by not incorporating the following Shop Drawing review time requirements into his project schedule. Allow at least ten (10) working days, exclusive of transmittal time, for review each time a Shop Drawing is submitted or resubmitted with the exception that fifteen (15) working days, exclusive of transmittal time, are required for the following:

I. Schedule:

1. Copies of all backflow preventer permits.
2. Certification of domestic water system disinfection.
3. Coordination Drawings, if required by this Specification.
4. Adjustment and balancing certification.
5. If more than five (5) Shop Drawings of this trade are received in one (1) calendar week.

J. List of Proposed Equipment and Materials: Within four (4) weeks after Award of Contract and before ordering materials or equipment, submit a complete list of proposed materials and equipment and indicate manufacturer's names and addresses. No consideration will be given to partial lists submitted out of sequence.

K. Responsibility:

1. The intent of submittal review is to check for capacity, rating, and certain construction features. Contractor shall ensure that work meets requirements of the 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 submittals marked "REVIEWED" to extent that they agree with the 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 the Contract Documents. The Architect's noting of some errors while overlooking others will not excuse the Contractor for proceeding in error. Contract Documents requirements are not limited, waived, nor superseded in any way by review.
2. Inform Subcontractors, Manufacturers, Suppliers, etc. of scope and limited nature of review process and enforce compliance with the Contract Documents.

L. Material and equipment requiring Shop Drawing Submittals shall include but not be limited to:

1. Plumbing fixtures and trim.
2. Water heaters.
3. Hose bibbs.
4. Piping.
5. Fittings, unions, flanges and couplings.
6. Insulation.
7. Sleeve packing.
8. Valves
9. Water hammer arresters.
10. Floor drains.
11. Backflow preventers.
12. Hangers, plates and inserts.
13. Receptors for indirect waste.
14. Fire-rated penetration assembles (ASTM E814, UL 1479).
15. Access panels.
16. Shop Drawings shall be submitted as a single bound package, organized and titled.

1.7 SURVEYS AND MEASUREMENTS

A. Base all required measurements, both horizontal and vertical, on reference points established by the General Contractor and be responsible for the correct laying out of the Plumbing work. In the event of a discrepancy between actual measurements and those indicated, notify the General Contractor in writing. Do not proceed with the work required until written instructions have been issued by the General Contractor.

1.8 COORDINATION

A. HVAC, Plumbing, Fire Protection, and Electrical Drawings are diagrammatic. They indicate general arrangements of Mechanical and Electrical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with Structural and other trades and to meet Architectural requirements.

B. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow speedy and efficient completion of the work.

C. Furnish to other trades advance information on locations and sizes of all frames, boxes, sleeves and openings needed for their work. Furnish information and Shop Drawings necessary to allow trades affected by the work to install their work properly and without delay.

D. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated, request information from Architect. Where the Plumbing work shall interfere with the work of other trades, assist in coordinating the space conditions to make satisfactory adjustments before installation. Without extra cost to the Owner, make reasonable modifications to the work as required by normal Structural interferences. Pay the General Contractor for additional openings, or relocating and/or enlarging existing openings through concrete floors, walls, beams and roof required for any work which was not properly coordinated. Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside of structure as possible.

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.

F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

G. Protect all materials and work of other trades from damage which may be caused by the Plumbing work, and repair all damages without extra cost to the Owner.

1.9 MECHANICAL AND ELECTRICAL COORDINATION

A. Plumbing Subcontractor shall furnish and install various electrical items relating to the plumbing equipment and control apparatus. The Electrical Subcontractor shall be required to connect power wiring to this equipment unless noted otherwise.

B. The Plumbing and Electrical Subcontractors shall coordinate their respective portions of the work, as well as the electrical characteristics of the plumbing equipment.

C. All power wiring and local disconnect switches will be provided by the Electrical Subcontractor for the line voltage power. All control and interlocking wiring shall be the responsibility of the Plumbing Subcontractor.

D. 120V and above power wiring sources extended and connected to heating and ventilating control panels, transformers and switches shall be the responsibility of the Electrical Subcontractor. All low voltage thermostats, zone valve and any switch wiring shall be the responsibility of the HVAC Subcontractor.

E. Temperature control and equipment wiring shall be installed by the Plumbing Subcontractor.

F. Pipe heat tracing shall be furnished and installed by the Plumbing Subcontractor. Power connections shall be by the Electrical Subcontractor.

G. The Electrical Subcontractor will provide all magnetic starters except those furnished as an integral part of packaged equipment.

1.10 COORDINATION DRAWINGS

A. Coordination Drawings:

1. The Sheetmetal Subcontractor shall prepare a complete set of 3D model electronic Drawings at a scale not less than 3/8” equals 1’-0”, showing structure and other information as needed for coordination. He shall show sheetmetal layout thereon. These will be the Coordination Drawings.

2. The main paths of egress and for equipment removal, from main Mechanical, Electrical, Plumbing and Fire Protection rooms must be clearly shown on the Coordination Drawings. All fire and smoke partitions must be highlighted on the Coordination Drawings for appropriate coordination.

3. Each of the below specialty trades shall add its work to these background Drawings with appropriate elevations and grid dimensions. Specialty trade information is required for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers, and for spaces in and above ceilings where congestion of work may occur such as corridors, and even entire floors. Drawings shall indicate horizontal and vertical dimensions, to avoid interference with structural framing, ceilings, partitions, and other services.

a. Specialty Trades:

1) Plumbing System.

2) HVAC Piping and Associated Control System.

3) Electrical.

4) Sheet Metal Work.

5) Sprinkler System.

4. Each specialty trade shall sign and date each electronic Coordination Drawing. Return Drawings to the Sheetmetal Subcontractor, who shall route them sequentially to all specialty trades.

5. Where conflicts occur with placement of materials of various trades, the Sheetmetal Subcontractor will be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialed and dated by the specialty trade. The Sheetmetal Subcontractor shall then final date and sign each Coordination Drawing. If he cannot resolve conflicts, the decision of the General Contractor shall be final, subject to the approval of the Architect.

6. A Subcontractor who fails to promptly review and incorporate his work on the Coordination Drawings shall assume full responsibility of any installation conflicts affecting his work and of any schedule ramifications.

7. The Sheetmetal Subcontractor shall make electronic copies of all Coordination Drawings. Fabrication shall not start until such electronic Drawings are received by the Architect/Engineer and have been reviewed.

8. Review of Coordination Drawings shall not diminish responsibility under this Contract for final coordination of installation and maintenance clearances of all systems and equipment with Architectural, Structural, Mechanical, Electrical, Plumbing and Fire Protection Contractors.

1.11 INSTALLATION REQUIREMENTS

A. The arrangement of all Plumbing work shown on the Contract Drawings is diagrammatic only and indicates the minimum requirements of the work. Conditions at the building including actual measurements shall determine the details of the installation. All work shall be laid out and installed so as to require the least amount of cutting and patching.

B. Review the Architectural Drawings and Specifications before ordering any material and equipment. Any discrepancies shall be brought to the attention of the Architect for his determination prior to proceeding with the work.

1.12 TYPICAL DETAILS

A. Typical details where shown on the Contract Drawings shall apply to each and every item of the project where such items are applicable. They are not repeated in full on the Contract Drawings, which in many cases are diagrammatic only, but with the intention that such details shall be incorporated in full. Any alternate method proposed for use by the Contractor shall have the prior approval of the Architect.

1.13 SLEEVES, INSERTS

A. Furnish and install all sleeves, inserts, anchor bolts and similar items to be set into masonry or concrete, as required for Plumbing work as indicated in Division 01. Internal diameter of sleeve ball shall be 1/2" larger than the outside diameter of the pipe or insulation covered line passing through it.

1.14 FIRESTOPPING, SMOKEPROOFING & WATERPROOFING

A. All cutting, patching, firestopping and waterproofing shall be performed by the Fire Suppression Subcontractor. Refer to Sections 01 73 29 – CUTTING AND PATCHING, 07 00 01 – WATERPROOFING, DAMPPROOFING & CAULKING, and 07 84 13 PENETRATION

FIRESTOPPING for project requirements.

1.15 CORING, DRILLING

A. Core, cut and/or drill all holes in walls and floors required for the installation of sleeves and supports for the Plumbing work as indicated in Division 01.

1.16 ACCESSIBILITY

A. Install all work such that parts requiring periodic inspection, operation, maintenance and repair are readily accessible.

B. Furnish all access panels appropriate to particular conditions, to be installed by trades having responsibility for the construction of actual walls, floors or ceilings at required locations.

1.17 SUPPLEMENTARY SUPPORTING STEEL

A. Provide all supplementary (non-structural) steelwork required for mounting or supporting equipment and materials.

B. Steelwork shall be firmly connected to building construction as required. Locations and methods of attachment shall be approved by the Architect.

C. Steelwork shall be of sufficient strength to allow only minimum deflection in conformity with manufacturer's published requirements.

D. All supplementary steelwork shall be installed in a neat and workmanlike manner parallel to floor, wall and ceiling construction: all turns shall be made at forty-five and ninety degrees, and/or as dictated by construction and installation conditions.

E. All manufactured steel parts and fittings shall be galvanized.

1.18 TOOLS AND EQUIPMENT

A. Provide all tools and equipment required for the fabrication and installation of the plumbing equipment at the site.

1.19 PORTABLE AND DETACHABLE PARTS

A. Contractors shall retain in their possession all portable and/or detachable parts and portions of materials, devices, equipment, etc. necessary for the proper operation and maintenance of the Mechanical and Electrical systems until final completion of the work, at which time they shall be handed over to the Owners.

1.20 RECORD DRAWINGS, PROJECT CLOSEOUT

A. As work progresses and for the duration of Contract, maintain a complete and separate set of prints of Contract Drawings at job site at all times. Record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to the original design. Work shall be updated on a weekly basis and shall be made available for review by Architect. Failure to perform this work shall be reason for withholding requisition payments. In addition, take photographs of all concealed equipment in gypsum board ceilings, shafts, and other concealed, inaccessible work. At completion of work, make copies of photographs with written explanation on back. These shall become part of Record Documents.

B. At the completion of work, prepare a complete set of electronic Record Drawings showing all systems as actually installed. The electronic copies will be made available for the Plumbing Contractor's copying, at his expense. The quantity of copies which are made available shall in no way be interpreted as setting a limit to the number of Drawings necessary to show the required information. The Plumbing Contractor's professional Draft Person shall transfer changes to

electronic copies. Submit sets of prints to Architect for comments as indicated in Division 01 – 01 77 00 CONTRACT CLOSEOUT.

C. The Architect will not certify the accuracy of the Record Drawings. This is the sole responsibility of the Plumbing Contractor.

D. This trade shall submit the Record Drawings for approval by the Fire and Building Departments in a form acceptable to the departments, when required by the jurisdiction.

E. Record Drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer, make and model numbers of final equipment installation.

1.21 GUARANTEE/WARRANTY

A. Guarantee and 24 Hour Service:

1. Guarantee Work of this Section in writing for not less than one (1) year following the date of acceptance by the Owner. If the equipment is used for temporary power etc, prior to acceptance by the Owner, the bid price shall include an extended period of warranty covering the one (1) year of occupancy, starting from the date of acceptance by the Owner. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to the Architect's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

2. In addition to guarantee requirements of Division 1 and of Subparagraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.

3. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the warranty period, the affected part or parts shall be replaced by this Contractor without any reimbursement.

4. Replace material and equipment that require excessive service during guarantee period as defined and as directed by Architect.

5. Provide 24 hour service beginning on the date the project is accepted by the Owner, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at no cost to the Owner. Service can be provided by this Contractor or a separate service organization. Choice of service organization shall be subject to Architect and Owner approval. Submit name and a phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

6. Submit copies of equipment and material warranties to Architect before final payment.

7. At end of guarantee period, transfer manufacturer's equipment and material warranties still in force to Owner.

8. This paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.

9. PART 2 paragraphs of this Specification may specify warranty requirements that exceed those of this paragraph. Those paragraphs shall govern.

10. Use of systems provided under this Section for temporary services and facilities shall not constitute Final Acceptance of Work by Owner, and shall not initiate the guarantee period.

11. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise the Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. The Architect and/or Engineer will direct

course of action.

1.22 OPERATING, INSTRUCTION AND MAINTENANCE MANUALS

A. Refer to Section 01 77 00 – CONTRACT CLOSEOUT and 01 78 23 – OPERATION AND MAINTENANCE DATA for submittal procedures pertaining to operating and maintenance manuals.

B. Each copy of the approved operating and maintenance manual shall contain copies of the approved Shop Drawings, equipment literature, cuts, bulletins, details, equipment and engineering data sheets and typewritten instructions relative to the care and maintenance for the operation of the equipment, all properly indexed. Each manual shall have the following minimum contents:

1. Table of Contents.
2. Introduction:
    a. Explanation of manual and its purpose and use.
    b. Description of the plumbing systems.
    c. Safety precautions necessary for equipment.
    d. Illustrations, schematics and diagrams.
    e. Installation drawing.
3. Maintenance:
    a. Maintenance and lubricating instructions.
    b. Replacement charts.
    c. Trouble-shooting charts for equipment components.
    d. Testing instructions for each typical component.
    e. Two (2) typed sets of instructions for ordering spare parts. Each set shall include name, price, telephone number and address of where they may be obtained.
4. Manufacturer's Literature:
    a. The equipment for which Shop Drawings have been submitted and approved.

1.23 QUALITY ASSURANCE

A. The requirements of the State Building Code and Local regulations establish the minimum acceptable quality of workmanship and materials, and all work shall conform thereto unless more stringent requirements are indicated or specified herein.

B. All work shall comply with the latest editions of the codes as referenced herein.

C. Follow manufacturer's directions for articles furnished, in addition to directions shown on the Contract Drawings or specified herein.

D. Protect all work, materials, and equipment from damage during process of work. Replace all damaged or defective work, materials and equipment without additional cost to the Owner.

E. All equipment and materials for permanent installation shall be the products of recognized manufacturers and shall be new.

F. Equipment and materials shall:

1. Where normally subject to Underwriters Laboratory Inc. listing or labeling services, be so listed and labeled.

2. Be without blemish or defect.
3. Not be used for temporary purposes.
4. Be in accordance with the latest applicable ASME standards.

G. Products shall meet with the acceptance of all Authorities Having Jurisdiction over the work. Where such acceptance is contingent upon having the products examined, tested and certified by Underwriters or other recognized testing laboratory, the product shall be so examined, tested and certified.

H. All items of equipment or material of one generic type shall be the product of one manufacturer throughout.

I. For items which are to be installed but not purchased as part of the Electrical work, the Electrical work shall include:

1. The coordination of their delivery.
2. Their unloading from delivery trucks driven into any point on the property line at grade level.
3. Their safe handling and field storage until the time of permanent placement in the project.
4. The correction of any damage, defacement or corrosion to which they may have been subjected. Replacement, if necessary, shall be coordinated with the Contractor who originally purchased the item.
5. Field erection and internal wiring as necessary for their proper operation.
6. Mounting in place, including the purchase and installation of all dunnage, supporting members, and fastenings, necessary to adapt them to architectural and structural conditions.
7. Their connection to building wiring including the purchase and installation of all termination junction boxes necessary to adapt and connect them to this wiring. Included also shall be the purchase and installation of any substitute lugs or other wiring terminations as may be necessary to adapt their terminals to the building wiring as called for and to the connection methods set forth in these Specifications.

J. Items which are to be installed but not purchased as part of the Plumbing work shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the Plumbing work will be considered only if presented in writing within one (1) week of the date of delivery to the project of the items in question. The Plumbing work includes all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

1.24 DELIVERY, STORAGE AND HANDLING

A. All materials for the work of this section shall be delivered, stored and handled so as to preclude damage of any nature. Manufactured materials shall be delivered and stored in their original containers, plainly marked with the products' and manufacturer's name. Materials in broken containers or in packages showing watermarks or other evidence of damage shall not be used and shall be removed from the site.

1.25 EXTRA MATERIALS

A. Furnish extra materials as indicated below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1. 10% of each water closet and urinal sensor flush valve battery installed.
2. 10% of each lavatory sensor faucet battery installed.

3. 10% of each lavatory/sink mixing valve installed.
4. 10% of each toilet seat installed.

PART 2 – PRODUCTS

2.1 PIPE MATERIALS

A. The table below indicates pipe class for each service. Refer to the following pages for expanded Specifications for the respective class.

PIPE MATERIALS SPEC INDEX

Service	Code	Maximum Operating (psig)	Service Limits (Temperature °F)	Pipe Material
Domestic Cold Water	CW	150 below grade	250	Copper
Domestic Hot Return	HWR	150 below grade	250	Copper
Domestic Hot Water	HW	150 below grade	250	Copper
Tempered Water	TW	100	250	Copper
Sanitary Waste & Vent	S	Gravity	120	PVC

B. Each valve type shall be the product of a single manufacturer. Each system shall be provided with valves as required by Code and shown on the Contract Drawings and shall be installed to facilitate operation, replacement and repair.

C. Provide access panels for concealed valves behind non-removable ceilings or walls.

D. Provide shut-off valves on supply piping to individual pieces of equipment. All new and existing plumbing fixture supply piping shall be provided with new shut-off valves. All existing shut-off valves supplying all existing plumbing fixtures shall be removed and replaced with new shut-off valves.

E. Provide pipe dope, Teflon tape, wax rings, neoprene gaskets and other jointing compounds as required by best standard practice and only on service as recommended by manufacturer.

F. Apply putties and jointing compounds for plumbing fixtures and trim as recommended by manufacturers.

G. Valves on insulated piping system shall be equipped with extended handles to accommodate insulation thickness.

H. Provide one-piece chrome plates escutcheons for all wall, floor and ceiling pipe penetration in finished rooms and areas.

2.2 COPPER PIPE (FOR CW, HWR, HW, TW SYSTEMS)

	1/2” to 3”	4” and Larger
Pipe	Seamless copper water tube, drawn temper, Type L. ASTM B-88. See Note 1.	Seamless copper water tube, drawn temper, Type L. ASTM B-8. See Notes 2 & 5.
Fittings	Wrought copper, solder-joint. ASTM B-16.22.	Ductile iron coupling with copper alkyd enamel paint coating, ASTM A-536. Grade “E” EPDM elastomer gasket. ASTM D-2000. Equal to Victaulic Style 606 coupling. ASTM B-75 copper alloy fittings. ASTM B-

		584 grooved end cast bronze fittings for 6” pipe size.
Joints	ASTM B-32 solder filled material, Alloy Sb5 “95/5.” ASTM B-813 liquid or paste flux. Soldering procedures shall comply with ASTM B-828.	Rolled groove prepared and assembled in accordance with manufacturer’s instructions.
Mechanical Joints	Cast copper alloy unions, hexagonal stock with ball-and-socket joint, solder joint ends. ASME B-6.18.	ANSI Class 150 flange adapter equal to Victaulic Style 641 for connections to flanged equipment. ANSI B-16.1 flange dimensions. Watts G-4000-FDA series.
Valves Gate	Use ball valve.	Use ball valve.
Ball	All bronze, 3 piece, full port, PTFE seats, solder end connections. 600 psig WOG. Apollo 82-200, Milwaukee BA-350, Watts B-6801.	Class 125, cast iron body, epoxy coated. Full port, flanged ends, stainless steel ball and stem. ANSI B16.1 flange dimensions. Watts G-4000 FDA series.
Check	Bronze body and clapper, solder ends, 200 WOG. Jenkins 4093, WOG. Milwaukee 1509, Stockham B-309.	Iron body, bronze mounted, flanged ends, 200 Jenkins 625-C, Milwaukee F-2974-M, Stockham G-931.
Balancing	All bronze, 2 piece, RPTFE seats, solder end connections. 600 psig WOG. Apollo 70-100, Milwaukee BA-150, Watts B-6001. CamLock handle.	Cast iron lug body butterfly valve. Bronze disc, replaceable EPT liner and stainless steel stem, 200 psig CWP.

A. Notes:

1. Below grade water piping 3” and smaller be Type K copper with bituminous coating copper brazed joints, BcuP filler alloy. ANSI/AWS A5.8 procedures shall be per ANSI/AWS B2.2.
2. Contact between dissimilar metals shall be made with dielectric couplings or dielectric flanges. Contact between ferrous and stud bolts and bronze flanges shall be electrically insulated with non-metallic washers.
3. Provide mechanical joint connections to all equipment such as water heaters, pumps, compressors, etc.
4. Copper Pressure-Seal-Joint Fittings for copper piping and valves may be installed in lieu of solder-type fittings.
    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following: Apollo Press; NIBCO Inc.; Viega.
    b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
    c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fittings with EPDM-rubber O-ring seal in each end.

2.3 SANITARY WASTE AND VENT

	Above Grade	Below Grade
Piping	Schedule 40 solid core PVC DWV piping conforming to ASTM D2665 & NSF-14, with ends for solvent cemented joints.	Schedule 40 solid core PVC DWV piping conforming to ASTM D2321 & NSF-14, with ends for solvent cemented joints.
Fittings	PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns.	PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns.
Joints	Solvent Cement: ASTM D 2564. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Primer: ASTM F 656. Primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).	Solvent Cement: ASTM D 2564. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Primer: ASTM F 656. Primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

A. Notes:

1. Copper tube and fittings shall not be used on urinal wastes.
2. Cellular (foam) core PVC piping is not approved for installation and shall not be installed.

2.4 PRESSURE, FLOW AND TEMPERATURE CONTROL DEVICES

A. Thermostatic Mixing Valves:

1. Pre-piped thermostatic mixing valve, inlet check valves, isolation valves, dial thermometer and mounting hardware.
2. Acceptable manufacturers: American Standard, Leonard or Symmons.

B. Pressure and Temperature Relief Valves on Water Heaters:

1. Combination pressure and temperature (P&T) relief valves shall be automatic, ASME-rated, AGA and CGA-certified, ANSI standard, bronze body. Pressure relieving setting shall be 150% of the working pressure of the unit to a maximum of 150 psi; temperature relieving setting shall be 120° F. Temperature relieving capacity shall be selected on AGA-CGA rating.
2. Valves shall be by Watts Regulator Co. Approved equivalent valves by Robertshaw or Cash-Acme may be provided.

C. Vacuum Relief Valves on Cold Water Inlet to Water Heaters and Tanks:

1. Relief valves shall be bronze body composition disc with 200 psi working pressure and 250° F temperature rating.
2. Valves shall be by Watts Regulator Co. Approved equivalent valves by Taco or B&G may be provided.

D. Vacuum Breakers:

1. Atmospheric vacuum breakers shall be all-bronze, for temperature up to 210° F: Watts 800

or equivalent by Neptune or Febco.

E. Strainers: Strainers shall be wye strainers, bronze body, stainless steel screens, 400 psi working pressure, threaded end with blow-off valved and piped to drain by strainers shall be Watts 777 series or equivalent by Wilkins or Febco.

2.5 INSULATION

A. Insulation shall be by Owens-Corning, Certain-Teed or Manville.

B. Insulation shall be installed by insulation firm regularly specializing in this work and employing men particularly skilled therein. No covering applied by plumber's "helpers" will be acceptable.

C. Insulation installation shall meet manufacturer's recommendations. No insulation shall be applied until piping has passed tests as required by Authorities Having Jurisdiction.

D. Insulation, jackets and adhesives shall be flame-retardant and shall have ASTM E-84 fire hazard ratings of 25 flame spread, 50 smoke developed and 50 fuel contributed.

1. Interior Applications – Jackets:

a. Type a – Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Jacket shall be heavy duty fire retardant material with glass fiber reinforcing and self-sealing lap. Jacket will be factory applied to the insulation. Jacket shall have neat, white Kraft finish or white vinyl suitable for painting, with bead puncture resistance of 50 units minimum. Vapor barrier shall be .001" aluminum foil adhered to the inner surface of the jacket. Permeance shall not exceed 0.02 perms. Jacket shall be Owens-Corning Fiberglass "ASJ-SSL" or Manville Flamesafe "AP-T".

b. Type b – PVC Jackets: One piece, pre-molded type.

E. Insulation and jacketing shall be in accordance with following:

1. Type A: Glass fiber insulation; ANSI/ASTM C547; "k" value of 0.22 – 0.28 at 100° F non-combustible.

2. Type B: Molded, flexible closed cell vinyl, ASTM D635; "k" value of 1.17 bacterial resistant.

F. Schedule: The following piping systems require insulation:

Piping System	Type	Insulation Thickness Inch (mm)	Jacket Type
Domestic Hot Water Supply/Return Less Than 1-1/2"	A	1"	a, b
Domestic Hot Water Supply/Return 1-1/2" and Larger	A	1-1/2"	a, b
Tempered Domestic Water Supply/Return Less than 1-1/2"	A	1"	a, b
Tempered Domestic Water Supply/Return 1-1/2" and Larger	A	1-1/2"	a, b
Domestic Cold Water	A	1"	a, b
Handicap Lav. Hot Water and Waste	B	1/8"	b

1. Notes:

a. Unless noted otherwise, Section "F" pertains to all piping specified system. This note pertains to all piping scheduled above.

G. Insulation of exterior piping and fittings shall be covered with 0.016" thick smooth aluminum jacket with longitudinal zee closures. Jacket shall be secured at both joints with 2" wide aluminum straps centered over butt joint of jacket. Provide ½" wide aluminum bands on 12" centers. Fitting covers shall be manufactured for purpose intended and shall be of same material.

H. Pipe hangers shall be outside insulation and shall incorporate 12”, 26 gauge protection shields. Insulation on piping that passes through walls or partitions shall pass continuously through sleeves, except at firewalls, smoke partitions and floor penetrations where space between sleeves and piping shall be fire stopped with approved packing.

I. Insulate equipment as specified. Refer to following equipment Specifications for additional requirements:

1. Water heaters.

2.6 PIPE SUPPORTS

A. Provide adjustable clevis hangers for hanger sizes 4” and larger and cast brass split-ring hinged hangers or band type hangers for smaller. Support piping from building structure to maintain required grade and pitch of pipe lines, prevent vibration, secure piping in place and provide for expansion and contraction. Hangers on all insulated pipe shall be clevis type.

B. Provide vertical brackets and guides for horizontal piping where it is racked along walls. Trapeze hangers may be used where conditions permit. Provide all necessary pipe clips, anchors and sundries for proper alignment and support of piping. Hangers for copper piping shall be coated for dielectric isolation. Hangers for PVC, polypropylene and other plastic piping shall be extended V-shaped, with angle iron pipe supports as necessary.

C. Hanger rods shall have machine threads. Beam clamps, concrete inserts and expansion shields shall be provided as required. No ramset or shot shields will be allowed.

D. Hanger spacing shall meet requirements of State and Local Plumbing Codes. In no case shall horizontal piping be supported at intervals greater than 10’-0”.

E. Piping below basement or lowest level slab (that is, buried piping), need not be supported from structure if slab is not designed as structural slab. The Plumbing Contractor shall support all piping under structural slabs on grade.

F. Pipe supports shall not bear on sleeves.

G. Friction clamps shall be installed at base of plumbing risers and at each floor. Friction clamps shall not be supported from or rest on sleeves.

H. Horizontal piping shall be suspended from building structure by mild steel rod connecting pipe hanger to inserts, beam clamps, angle brackets and lag screws as required by Building Construction in accordance with the following:

Rod Size	Pipe Size
3/8”	1/2" to 2”
1/2"	2-1/2” to 4”
5/8”	5” to 12”
3/4"	15”

I. Hangers on insulated lines shall be sized to fit the outside diameter of pipe insulation. Provide hangers for insulated piping with 12” long, 18 gauge galvanized insulation shields.

J. Piping at equipment and control valves shall be supported to prevent strains or distortions in connected equipment and control valves. Piping at equipment shall be supported to allow for removal of equipment, valves and accessories with a minimum of dismantling and without requiring additional support after these items are removed.

K. Piping installed under this Section shall be independently supported from building structure by means of beam attachments and not from piping, ductwork or conduit of other trades. Supplementary steel, including factory-fabricated channels, required to meet the requirements specified herein, shall be provided by the Plumbing Contractor.

L. Maximum spacing of hangers on runs of steel, copper or brass pipe shall be as follows:

Schedule: Hanger Spacing in Feet/Pipe Material		
Pipe Size (Inches)	Steel (Feet)	Copper or Brass (Feet)
1/2 to 1	7	5
1 to 1/4	10	6
1 to 1/2	10	8
2 to 8	10	10

M. Maximum spacing of hangers on no hub cast iron soil pipe shall be 5’ and hangers shall be provided at all changes in direction. Hanger rods to support piping from the structure or supplementary steel shall not exceed 4’ in total length. Where pipe support assemblies exceed 4’ in total length, Plumbing Contractor shall provide factory-fabricated channels and associated accessories.

2.7 SLEEVES, INSERTS, FIRE STOPPING AND ESCUTCHEONS

A. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter one inch larger than the outside diameter of pipe. Pipe Sleeve Materials:

1. Sleeves through floors and through exterior, structural and fire-rated construction, shall be hot dipped galvanized Schedule 40 steel pipe. Sleeves shall extend 1” above finished floor.

2. Sleeves through partitions and non-fire-rated construction shall be 26 gauge galvanized steel with lock longitudinal seams or approved plastic pipe.

3. Provide waterproofing membrane locking devices at floors. Provide 150 lb. Slip-on welding flanges at exterior wall penetrations.

4. Provide one-piece chrome plates escutcheons on all wall, floor and ceiling pipe penetrations in finished rooms and areas.

B. Fire stop penetration seals in fire-rated construction shall be products of STI SpecSeal, 3M, Proset Systems Firefill or Dow and shall be installed in accordance with the latest requirements of ASTM E814 (UL 1479). Fire stop penetration sealants for non-metallic and insulated piping shall be intumescent (STI SpecSeal Series 100 Sealant or SpecSeal Collar or approved equal). Provide mineral fiberboard, matting or putty for damming and forming. Finish seals flush to wall surface and fill gaps with silicone adhesive sealant caulking (Dow 96-081 RTV or approved equal). Provide 1” thick ceramic fiberboard on both sides of penetrations in 2 and 3 hour rated walls and floors less than 8” thick.

C. Packing for sleeves that do not require maintenance of fire rating shall be oakum, silicate foam, ceramic fiber or mineral fiber with approved sealant. Pack or foam to within one inch of both wall surfaces. Seal penetration packing with approved caulking and paintable waterproof mastic surface finish or silicone caulking.

D. Waterproof Pipe Penetrations:

1. Sleeves through outside walls shall be provided with pipe to wall penetration closures equal to Link-Seal Thunderline Corporation. Seals shall be mechanical type of interlocking rubber links shaped to fill space between pipe and sleeve. Links shall be assembled with bolts to form a belt around the pipe with pressure plate under each bold head and nut. After seal assembly is positioned, tightening of bolts will provide watertight seal. This Contractor shall determine the required inside diameter of each individual sleeve before ordering, fabricating or installing. The inside diameter of each sleeve shall be sized as recommended by the manufacturer to fit the pipe and Link-Seal to assure a watertight joint.

2. Prefabricated modular sleeves shall be Mason Industries (SWS) or approved equal stiffened

galvanized steel sleeves with preformed closed-cell elastomeric seal (non-fire rated) or preformed mineral fiber or silicone foam seal (fire rated).

3. Provide waterproof 1” single ring set in silicone and bolted to floor or wall at chipped and drilled penetrations of existing slabs on grade and existing walls below grade.

E. Inserts shall be individual or strip type or pressed steel construction with accommodation for removable nuts and threaded rods up to 3/4" diameter, permitting lateral adjustment. Individual inserts shall have an opening at the top to allow reinforcing rods up to 1/2" diameter to be passed through the insert body. Strip inserts shall have attached rods with hooked ends to allow fastening to reinforcing rods.

F. Unless otherwise specified herein, escutcheons shall be cast brass chrome plated type and provided with a set screw to properly hold escutcheon in place.

2.8 CLEANOUTS, TRAPS AND STRAINERS

A. Provide cleanouts in soil, waste and storm drainage piping on straight runs at changes in directions and at foot of stacks and other points where required by inspecting Authorities. Cleanouts shall suit construction in which they are to be installed.

B. Maximum horizontal distance on straight runs between cleanouts shall be 50 feet.

C. Cleanouts shall be same size as pipe 4” and smaller. Cleanouts for piping larger than 4” shall be sized per local code and in no circumstance shall they be less than 4” in diameter. No reduction in cleanout sizes for pipe 4” and smaller is permitted.

D. Traps not integral with fixtures and in accessible locations shall have brass trap screw protected by water seal and will be regarded as cleanout.

E. Bodies of cleanout ferrules in bell and spigot piping shall be standard pipe sizes conforming in thickness to that required for pipe and fittings and shall extend not less than 3/4" above hub of pipe.

1. Cleanout plug shall be cast brass with raised nut 3/4" high.

2. Cleanouts in copper waste piping shall be soldered brass cleanout fittings with extra heavy brass screw plugs of same size as line.

3. Cleanouts in threaded waste piping shall be cast iron, drainage T pattern, 90 branch fitting with extra heavy brass screw plugs of same size as pipe.

4. Floor cleanouts in finished areas shall be per schedules equivalent to J.R. Smith, Wade or Zurn.

5. Floor cleanouts in unfinished areas shall be per schedules equivalent to J.R. Smith, Wade or Zurn.

F. Provide test tees with cleanout plugs at foot vertical soil, waste, acid waste and roof conductor lines and at each floor. Cleanouts on vertical lines concealed behind finished walls shall extend to back of finish wall; provide wall plate. Obtain Architect’s approval for wall plate locations and reroute piping if necessary.

G. Cleanouts shall open in direction of flow of drainage line served or at right angles thereto.

H. Keep cleanout plugs clean and unimpeded. Prevent covering with cement, plaster or other permanent finished materials.

I. All cleanouts shall be installed flush to wall and/or floor. Cut and patch walls and/or floor as required for proper installation.

2.9 THERMOMETERS AND PRESSURE GAUGES

A. Provide bronze Bourdon tube pressure gauges where shown on Contract Drawings and where specified, by U.S. Gauge, Trerrice or Weksler, accurate to +1%.

1. Gauges shall have white faces with black-filled engraved lettering. Gauge bodies shall be set in phenolic cases. Provide pulsation dampers and gauge cocks to isolate each gauge.

2. Gauges shall be easily accessible and easily read. Gauges readable from floor at less than 5 feet shall be 4-1/2” dials. Other gauges shall have 6” dials. Gauges graduations shall meet limit requirements of normal operation. Gauges shall indicate at mid-scale.

B. Provide separable well V-case thermometers by U.S. Gauge, Terrice or Weksler where shown on Contract Drawings and where specified. Thermometers shall have 9” scale and white face with black-filled engraved letters. Thermometers shall be angular or straight stemmed, as conditions necessitate. Thermometer wells shall be bronze and shall be installed so as to ensure minimum restriction of water flow in pipe and shall be installed to be able to be viewed from the floor.

1. Provide thermometer at the inlet and outlet of each water heater and where shown on Contract Drawings. Thermometers shall have scale range of 30°-240° F with 2° scale division.

2. Provide thermometer in hot water return system at each hot water recirculation pump and where shown on Contract Drawings. Scale range shall be 30°-240° F with 2° scale division.

2.10 WALL HYDRANTS AND HOSE BIBBS

A. Provide wall hydrants as shown on the Contract Drawings. Provide hose bibbs in every toilet core where more than one (1) flushing fixture is shown.

B. Wall hydrant shall be recessed box anti-siphon, non-freeze, key-operated, 3/4". Hydrant shall be J.R. Smith or equivalent by Josam or Zurn. Coordinate cover and plate finish with Architect prior to ordering any units.

C. Hose bibb shall be chrome plated bronze or brass with replaceable hexagonal disc, hose thread spout and integral vacuum breaker in conformance to ANSI/ASSE 1011. Hose bibb shall be equal to Chicago No. 952 or equivalent, T&S Brass or Watersaver.

2.11 WATER HAMMER ARRESTERS

A. Provide water hammer arresters at fixtures with automatic solenoid or cylinder operated valves, automatic flush valves quick-closing valves or solenoid valves and where indicated on Contract Drawings.

B. Fixtures and equipment in battery installation may use single water hammer arrester properly sized for connected load.

C. Provide proper access to water hammer arresters in chases, utilizing a minimum 12” x 12” access panel furnished by this Contractor.

D. Water hammer arresters shall be installed in accordance with manufacturer’s recommendations and not less than one (1) installed per core piping hot system and core piping cold system. Arresters shall be equal to J.R. Smith, Zurn or PPP.

2.12 PLUMBING FIXTURES AND TRIM

A. Refer to Architectural and Plumbing Drawings for quantities, locations and mounting heights of fixtures provided under this Section.

1. Refer to Fixture Schedules on P0.01.

B. Fixture trim, traps, faucets, escutcheons and waste pipes exposed to view in finished spaces

shall be I.P.S. brass with polished chromium plating (CP) over nickel finish.

C. Vitreous china fixtures shall be regular selection fused and vitrified to produce homogeneous material with close grain without pores. Surfaces that contact walls, floors and other fixtures shall be set true.

D. Enameled surfaces on cast iron fixtures shall be of suitable thickness to provide the highest commercial grade. Exterior exposed surfaces not enameled shall be treated at factory with one (1) coat of filler.

E. Affix manufacturer's guarantee label or trademark to fixture to indicate first quality. Acid-resisting enamel fixture shall bear manufacturer's symbol signifying resistance to acid.

F. Set fixtures with wall outlet flanges at proper distance from floors and walls with closet setting compound or gasket.

G. Catalog designations and manufacturer's names of vitreous china and enameled cast iron fixtures are specified to establish standards of quality for performance and materials. Equivalent fixtures by Toto, American Standard or Eljer may be submitted for consideration.

H. Vitreous china and enameled cast-iron fixtures shall be white throughout, unless specified otherwise. Closet seats shall match closet fixture color.

I. Fixture Types: As listed on Contract Drawings.

1. Notes:

a. Standards:

1) Floor Drains:
a) Cast Iron – ASME A112.21.1M
b) Plastic – ASTM A112.21.M
c) Cast Iron Trench Drains – ASME A112.21.1M
2) Cleanouts: Cast Iron – ASME A112.36.2M
3) Sleeve Systems: UL 1479

2.13 EQUIPMENT – GENERAL

A. The following mechanical equipment is to be supplied by a single manufacturer as part of this package unless otherwise noted.

1. Refer to Equipment Schedules on P0.1.

B. Equipment Tags:

1. All equipment shall be tagged using black phenol background with a 1/4" white engraved lettering tag affixed to the piece. Tag shall be minimum of 2" high and 4" long for large equipment and shall include the tag number and the piece.

2. Equipment Tag Sequence (Example):

a. G-CMP – 1XXX where:

b. G – Indicates system (Natural Gas)

c. CMP – Indicates equipment (Booster Pump)

d. 1 – Indicates piece number (1, 2, 3…)

e. XXX – Indicates building number (if applicable)

C. All equipment furnished in the following pages shall be furnished with seismic anchoring points. Equipment supplied shall be constructed with a seismic rating.

2.14 WATER HEATERS

A. Provide water heaters of sizes and types indicated on the schedule sheets. Heaters shall be tested at 200 psi and rated for working pressure of 150 psi and shall bare stamp certifying testing and rating. Tanks with capacity greater than 120 gallons or input rating greater than 200,000 Btu/hr shall meet ASME Boiler and Pressure and Vessel Code requirements.

1. Refer to Equipment Schedules on P0.1.

B. Provide pressure and temperature relief valve and vacuum relief valve.

1. Pressure and temperature relief valves shall be at least 3/4" and shall be rated and listed for heater input rating and as required by ANSI and ASME Standards. Temperature relief valves shall be installed within top 6” of tank.

2. Vacuum relief valves shall meet ANSI standards requirements and shall be rated and listed for heater input rating and as required by ANSI and ASME Standards. Temperature relief valves shall be installed within top 6” of tank.

C. Storage type heaters shall have minimum standby heat loss in accordance with requirements of State Energy Code. Tank and heaters which are not factory insulated and jacketed shall be field insulated.

D. Field insulation of tanks and heaters shall consist of minimum of 2” fiberglass insulation. Refer to insulation paragraph for additional requirements.

1. Insulation shall be cut or mitered where necessary to fit shape and contour of equipment. Insulation shall be banded or wired in place on 12” centers or impaled over pins on 18” centers. Point up open joints with insulating cement.

2. Apply 1” hexagonal mesh over insulation, lacing edges together. Apply 1/2" thick coat of insulating cement and trowel to smooth finish. Adhere glass cloth jacket over cement with approved lagging adhesive. Size jacket with one brush coat of lagging adhesive.

E. Heaters and tanks shall be of size and type as scheduled on Contract Drawings.

PART 3 – EXECUTION

3.1 DEMOLITION

A. Disconnect and dismantle existing plumbing systems and equipment to be demolished and leave debris and disconnected equipment on floor for removal under Section 20 70 00 – SELECTIVE DEMOLITION.

B. Remove existing plumbing stacks, mains and branches when serving fixtures to be demolished. Remove piping back to active main and provide valve cap or plug to suit system. Obtain existing record Drawings from Owner. Maintain existing plumbing risers and stacks serving fixtures to remain.

C. After walls and ceilings are removed and piping is exposed, verify piping serves only plumbing fixtures indicated for demolition before shut-down for disconnection. Identify existing piping which serves fixtures to remain. Promptly notify Architect of active piping to be maintained when located in partitions to be demolished.

D. Remove existing stacks and risers located in existing partitions to be demolished and provide new off-set at ceiling and drop through floor and reconnect to existing services at the floor below.

3.2 COORDINATION

A. Cooperate and coordinate with work of other Sections in executing work of this Section.

3.3 EXPANSION PROVISIONS

A. Allow for expansion with offsets, loops, swing joints, expansion joints and other means, where necessary to protect piping systems as shown. Take-offs from mains to run outs shall not have less than a three (3) elbow swing.

B. Anchor mains and risers with loops or offsets to structure to impart expansion toward loops and offsets. Anchors shall be forged wrought iron, secured to pipe and structure. Provide vibration isolation as required and as specified.

C. Provide pipe alignment guides to guide expanding pipe to move freely from anchor points towards expansion joints, offsets and other expansion provisions.

3.4 PIPE IDENTIFICATION

A. Provide color-coded pipe identification markers on piping installed under this section. Pipe markers shall be snap-on laminated plastic protected by clean acrylic coating. Pipe markers shall be applied after Architectural painting where such is required.

B. Provide arrow marker with each pipe content marker to indicate direction of flow. If flow can be in either direction, use double-headed arrow marker.

C. Main shall be labeled at points of entrance and exit from mechanical room, adjacent to each valve, on each riser, at each tee fitting, at points of entrance and exit from building, at least once in each room and at intervals no longer than 20’.

D. In general, 2” high legend shall be used for pipe lines 4” in diameter and larger, and 3/4" high legend shall be used for pipe lines 3” in diameter and smaller.

E. Markers shall be Seton, MIS or approved equivalent.

F. Color banding shall meet ANSI latest and OSHA requirements.

G. Markers shall have legends and color coding with black letters:

1. Markers are to be applied to all piping, regardless of under jacket colors per the following schedule:

Service	Legend	Background Color
Cold Water	Cold Water	Green
Hot Water	Domestic Hot Water	Yellow
Hot Water Return	Domestic Hot Water Return	Yellow
Sanitary	Sanitary Sewer	Green
Vent	Vent	Yellow

H. In Mechanical Rooms, Storage Rooms, Janitor’s Closets and other areas without hung ceilings, colored PVC jackets shall be used per the schedule.

1. All insulated piping exposed in mechanical rooms shall be covered with a Ceel-Co plastic jacket. Color pattern and system identification legend shall be as in the schedule.

2. This plastic jacket shall include fitting covers and piping covers.

3. Piping to be covered with this plastic jacket shall be insulated and finished as herein specified and then the plastic jacket shall be applied.

3.5 TAGS, VALVES, EQUIPMENT AND INSTRUMENTS

A. Upon completion of work, attach engraved laminated plastic tags to all valves and instrumentation. Equipment shall bear a stamped stainless tag. Tags shall have black characters on white face, consecutively numbered and prefixed with letter “P” for general valves. Tags shall bear the number used in the P&IDs for those items so marked.

B. Embossed or engraved aluminum or brass tags may be substituted if desired. Tags shall be at least 1/8” thick.

C. Tags shall be at least 1” diameter with numerals at least 3/8” high and attached by “S” hooks and chains.

D. Nameplates, catalog numbers and rating identifications shall be securely attached to electrical and mechanical equipment with screws or rivets. Adhesives or cements will not be permitted.

E. Non-potable water outlets shall be identified with permanently attached yellow color-code or 4” high triangle tag reading “Water Unsafe”.

F. Coordinate numbering system with existing piping tags as not to duplicate numbers.

3.6 FLASHING AND COUNTERFLASHING

A. Floor drains shall be flashed watertight with 20 ounce sheet copper flashing which shall extend 8” beyond drain flashing flange.

3.7 JOINTS AND CONNECTIONS

A. Joints and connections shall be permanent and shall be gas and water-tight. Jointing shall be types specified for serviced indicated. Joints and connections shall meet requirements of manufacturer’s best recommended practice. All transitions between different piping materials shall be made using approved adapters. Adapters for transitions between two (2) types of piping materials shall be manufactured for purpose intended.

3.8 INTERIOR WATER SUPPLY SYSTEM

A. Provide a complete, new (domestic and/or protected) hot and cold water piping system as indicated on Contract Drawings and as specified, including supplies to fixtures and indicated equipment. Piping shall be pitched at least 1” in 40 feet so that it can be drained completely at low points with drain valves. Piping shall be pitched up toward fixtures for proper air relief. Provide automatic air vents with outlet piped to floor and gate valve ahead of air vents, where offsets cannot be vented by means of fixture connections.

1. Pipe used in piping assembly shall be clean and shall have ends square and reamed before putting into fittings.
2. Cut tube to required length with hacksaw or tube cutter designed for copper work.
3. Remove burrs from inside and outside of cut edge and clean end of tube with steel wool or sand cloth until discoloration is removed and metal is smooth and bright.
4. Oxides shall be removed by sand cloth and brush.
5. Removal of oxides or discoloration of pipe and fittings by acids or self-cleaning flux is forbidden.
6. Apply a thin, uniform and complete coating of reliable brand of soldering flux (Nokorode or Crest) to cleaned surfaces of tube and fittings.
7. When joints are soldered, remove excess solder with a cloth or brush leaving a fillet of solder in chamber at end of the fitting.
8. Where quick closing valves such as solenoid or flush valves are being used, piping shall be

protected from water hammer by shock absorbers. Shock absorbers shall be installed at all batteries of fixtures that are operated by flush valves. Shock absorbers shall be as manufactured by PPP, J.R. Smith, or Zurn, and shall conform to the Plumbing and Drainage Institute (PDI) published requirements.

9. Connections to tanks and equipment shall be made with unions.
10. Water services supplying the building shall flow through in-line strainers and shall have containment backflow protection as indicated.
11. Shut-off and control valves on main distribution and branch lines shall be located for easy access and operation. Branch piping shall be valved with access panels provided as required at locations shown on Contract Drawings and determined in field.
12. Specialty piping and fittings (copper pressure-seal-joint fittings, etc.) shall be installed in strict accordance with manufacturer's installation guidelines, requirements and recommendations. Join tubing and fittings with tools recommended by fitting manufacturer.

3.9 INTERIOR SANITARY WASTE AND VENT PIPING

A. Provide waste, drainage and vent lines shown in building as shown on Contract Drawings. Vents shall extend through roof and shall increase to at least 4". Piping shall be assembled and installed without undue strains and stresses and provision shall be made for expansion, contraction and structural settlement.

B. Interior horizontal sanitary waste and storm drainage piping shall be installed in practical alignment at uniform grade of at least 1/8" per foot, but 1/4" per foot where code dictates and as shown on Contract Drawings.

C. Vents from fixtures or line of fixtures, when connected to vent line serving other fixtures, shall be extended at least 6" above flood level rim of highest of fixtures to prevent use of vent line as waste. No vent terminal shall be directly beneath door, window or other ventilating opening of building, nor shall any vent be within 12 feet horizontally of such opening.

D. Provide sleeves for pipe that pass through walls.

E. Provide 3" air gap on equipment and drains that discharge to floor drains.

F. Provide an air gap in which the vertical distance through the free atmosphere between the waste pipe and the floor rim of the receptacle into which it is discharging is a minimum of 2 pipe diameters greater.

G. Piping shall be run straight and plumb and offsets shall be made at an angle of not less than 45.

H. Carefully lay out work in advance so pipes pass through openings and permit proper pitch to stacks. Due to extensive ventilation and lighting systems all trades shall coordinate work with work of other trades.

I. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.

J. For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D 2855 and ASTM D 2665 appendixes.

K. Cleanouts:

1. Provide cleanouts with brass caps and screws same size as pipe up to 4 inches and not less than 4 inches for larger piping at the ends of all branches on soil and waste piping and in such other portions of the piping where run is over 50 feet. Locate floor cleanouts as indicated on Contract Drawings.
2. All cleanouts shall be installed flush to wall and/or floor. Cut and patch walls and floor as

required for proper installation.

3.10 FIXTURE ROUGHINGS

A. Install rough plumbing including fixture carriers and supports, valves and water hammer arresters within chase tolerances. Supply roughing through finish walls and at hose bibbs and shower heads shall be secure and free of movement. Locate valves and water hammer arresters within 12 inches of approved access panel location.

B. Align exposed waste and supply pipe roughings with fixture connections within 1 inch tolerance. Provide flush valves in alignment with the fixture, without vertical or horizontal offsets. Obtain fixture manufacturer roughing data sheets for recommended roughing dimensions.

C. Provide fixture templates for Casework Contractor for counter mounted sinks and lavatories.

1. Rough handicapped use water closets to locate the flush valve handle on the wide side of the toilet stall.

D. Secure fixture supports to floor slab construction with lag bolts and metal expansion shields to support at least 250 pounds on the front rim of the fixture for 5 minutes.

E. Mounting heights shall be in accordance with all local and state codes and latest ADA Standards.

F. Provide fixture rough-in piping connections, sizes in accordance with schedule on Contract Drawings.

3.11 EQUIPMENT ROUGHINGS AND CONNECTIONS

A. Provide roughing and final connections for water, waste, air and gas systems including indirect wastes, traps, tailpieces, stops and supplies, valves and unions for all equipment and fixtures including those supplied under other sections.

B. Provide complete plumbing roughings with capped and valved service with union of flange to suit Owner furnished equipment.

C. Refer to Architectural floor plans and Equipment schedules for all equipment provided under other sections or by Owner. Roughing for all equipment including floor drain locations shall be based on approved Shop Drawings. Install indirect waste discharge to spill into floor drain funnel. Floor drain grate and sediment bucket shall be removable.

3.12 INSTALLATION OF SPECIALTY ITEMS

A. Install vacuum relief valves located above the top of the heater on cold water supply lines to water heaters.

B. Gauges: Install gauges where indicated on the Contract Drawings and as specified. Install pressure gauges at water service entrance on inlet and outlet sides of strainers, filters, backflow preventers and pumps. Install temperature gauges on inlet and outlet side of water heaters and on recirculation line at least 10 feet upstream of circulation pumps. Gauges shall be legible from 4 feet to 6 feet above the floor.

C. Trap Primers: Install trap primer and related piping through the floor and connect to primer connection on floor drains in all areas where maintaining the trap seal could be a problem. Trap seal gaskets may be installed if acceptable by Code and Local Authority Having Jurisdiction.

D. Water Hammer Arresters: Provide water hammer protection at all self-closing fixtures and equipment. Equip quick-closing valves such as flush valves and solenoids with water hammer arresters. Banks of plumbing fixtures may be protected with a single properly sized and located PDI certified arrester. Obtain approval for access panel location prior to installation.

3.13 INSTALLATION OF FIXTURES

A. Mount fixtures level at the elevations shown on Architectural Drawings. Refer to toilet room elevations and casework details.

B. Install handicapped use fixtures in accordance with the requirements to the Architectural Access Board Code, latest ADA standards and ANSI A117.1. Insulate hot water supply and waste piping under lavatories.

1. Where urinals are provided, install one urinal with the rim mounted 17 inches above the finish floor in compliance with the Handicapped Code.

C. Grout walls and floor mounted fixtures watertight where the fixtures are in contact with walls and floors.

D. Caulk deck-mounted trim at the time of assembly, including fixture and casework mounted. Caulk self-rimming sinks installed in casework.

3.14 CLEANING

A. Clean systems thoroughly before testing. Fixtures, equipment, pipe, valves and fittings shall be free of grease, metal cuttings, dirt and other foreign material. Remove protective covers. Fixtures (including lavatories, water closets and urinals) shall be cleaned and ready for use.

B. Repair stoppage, discoloration and damage to parts of building, finish and furnishings due to failure to properly clean piping system within Contract Price.

C. After completion of project, clean the exterior surface of equipment included in this section, including concrete residue.

D. After the completion of the work, all materials and equipment surfaces shall be thoroughly cleaned and polished in accordance with the finish of the material. All chromed surfaces shall be highly polished.

E. Before the systems are tested and balanced, pipes and equipment shall be thoroughly cleaned so that no dirt, dust, or other foreign matter will be deposited in or carried through the systems.

F. Water systems shall be thoroughly flushed and cleansed of any and all deleterious materials at least once before system is placed in operation. At this time, these systems will be carefully checked for leaking and defects as hereinafter specified. An approved cleansing agent will be used in flushing.

G. At all times, keep the premises clear of undue accumulation of rubbish.

H. On completion of the work, remove all rubbish and debris resulting from this contract and dispose of same. At any time should the General Contractor be dissatisfied with the performance of clean-up responsibilities, he may elect, after proper notification, to undertake this operation and back charge this Subcontractor accordingly.

I. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion.

3.15 DISINFECTION OF WATER SYSTEMS - INTERIOR AND EXTERIOR

A. Water piping systems shall be thoroughly disinfected with a solution containing no less than 50 parts per million of available chlorine. Chlorinating materials shall be either liquid chlorine or sodium hypochlorite solution, and shall be introduced into the system and drawn to all points in the system. Disinfection solution shall be allowed to remain in system for 24 hours. During this time, valves and faucets shall be opened and closed several times. After disinfection, solution shall be flushed from the system with clear water until residual chlorine content is no greater than 0.2 parts per million.

1. Notify all parties 48 hours prior to cleaning system.
2. Bypass all building filters.
3. Perform chlorination prior to heating the domestic hot water system. Run circulation pumps on the domestic HW system.
4. Provide advance notice to all trades prior to procedure. Post warning signs throughout the job site.
5. Collect samples randomly and at end user points.

B. Work shall be supervised by Owner and performed by approved chemical testing laboratory and results sent to the Architect or Architect's representative for verification.

3.16 TESTING AND ADJUSTING – GENERAL

A. Scope:

1. Test and adjust plumbing systems as specified and as required by Code and Contract Documents..
2. Testing, balancing and adjusting shall in no way relieve guarantee requirements.
3. Provide services of qualified personnel, equipment and apparatus required to perform tests.
4. All systems shall be thoroughly adjusted for perfect intended operation. All mechanical equipment shall be adjusted for flow, temperature, etc. of fluid. The entire hot water circulation system shall be thoroughly balanced so hot water draw from fixtures shall be as quickly available as possible. Pumps, relief valves and pressure reducing valves shall be adjusted as required. Submit in writing to the Engineer upon completion of this work that it is complete and ready for use.

B. Before date of acceptance, furnish Architect with certificates of testing and inspection indicating approval of Authorities Having Jurisdiction and conformance with requirements of Contract Documents.

C. General:

1. Submit proposed test procedures, recording forms and test equipment for review before testing.
2. Notify Architect and Authorities involved at least 48 hours before testing and inspection.
3. Do not paint, cover or conceal work before testing, inspecting and obtaining approval; this includes backfilling and application of insulation.
4. Costs of repairs and restoration of work of other trades and of existing building surfaces or material damaged during cleaning or testing shall be borne by trade performing cleaning or testing.

D. No tests shall be started until systems have been cleaned as described under "Cleaning" paragraph. Provide temporary piping and connections for testing, flushing or draining systems to be tested.

1. Repair or replace leaks, damage and defects that result from tests to like-new condition. Remove and replace defective materials with acceptable materials.
2. Piping and joints shall be made tight without caulking. Continue tests until systems operate without adjustments and repair to equipment or piping.
3. Provide testing instruments, force pumps, gauges, equipment and labor necessary to conduct tests. Instruments used for testing and balancing shall have been calibrated within six months before balancing. Instrument calibration shall be certified.'

4. Submit six (6) copies of complete testing and balancing report to Architect for review.

E. Final test shall be made after vertical and horizontal pipes and roughing-in have been run and before sewer or fixture connection is made.

1. After soil, waste and storm lines, etc. have been installed outlets shall be temporarily plugged up.
2. Fill pipes with water to top of vertical lines and allow them to remain so filled for 24 hours.
3. Retesting after leaks are repaired shall be at no additional cost.

F. Pressurized Piping Systems:

1. Leak tests shall be conducted in accordance with ANSI applicable codes and as specified herein.
2. Before piping of various systems has been covered or furred-in, piping systems shall be tested tight for 1 hour under hydrostatic pressure, 1-1/2 times systems working pressures, but not greater than test pressure of 150 psig.
3. Tests shall be witnessed by Architect and pronounced satisfactory before pressure is removed or any water drained off.
4. Equipment shall be valved off or removed during test if equipment pressure rating is less than test pressure.
5. Retest systems after leaks are repaired within Contract Price.

G. Gravity Systems: Test under water pressure at heads specified in Plumbing Codes. Fill pipe lines with water to top of 5 foot vertical section of pipe or to level of top of vent pipe; maintain head pressure for 30 minutes.

H. Potable Water System Test:

1. Certification of the potable water system integrity shall be required where separate systems of potable and non-potable water are provided to supply plumbing fixtures.
2. Fill potable water system to capacity with clean clear water. Introduce water at top of piping system (Hot and Cold). During filling, introduce green food coloring dye into piping system. A floor-by-floor survey shall be conducted. Operate each outlet (Hot and Cold) connected to potable water system until coloring has been observed. A method of maintaining the level of water and coloring shall be employed in order to make up the drawn off amounts. A survey sheet shall indicate each floor and the room number sequentially.
3. This survey is required to be performed after all pressure testing and flushing of the piping system, but before sterilization. Further, it is required that all fixtures connected to the potable water system be installed prior to the test.

I. Prove capacity and performance of each piece of equipment by field tests as specified herein various paragraphs. Equipment and instruments required for tests, as well as additional thermowells or gauge connections shall be installed at no additional cost to Owner.

1. Qualified representative of Equipment Manufacturer shall be present. Architect may witness tests, if he so desires.

3.17 TESTING: PIPING SYSTEMS

A. General:

1. Piping systems shall be subjected to testing water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until joints are inspected.

2. Tests shall be witnessed by inspector having jurisdiction, and the Architect within 48 hour notice, given these Authorities.
3. Equipment, material, and labor required for testing of various systems, or part thereof, shall be provided by Plumbing Contractor.

B. Sanitary, Waste System:

1. Water test shall be applied to drainage system either in their entirety or in sections as required, after rough piping has been installed.
2. If applied to entire system, openings in piping system shall be tightly closed, except the highest opening and system filled with water to point of overflow.
3. If system is tested in sections, each opening shall be tightly closed except highest opening in the section under test and each section shall be filled with water but no section shall be tested with less than a 10’ head of water.
4. In testing successive sections, at least upper 10’ of next preceding section shall be tested so that no joint of piping in building, except the uppermost 10’ of the system shall be submitted to a test of less than a 10’ head of water.
5. Water shall be kept in system for at least 15 minutes before inspection starts; the system shall then be made tight at all points.

C. Points of drainage systems tested with air instead of water shall be tested by attaching an air compressor testing apparatus to suitable opening and, after closing all other inlets or outlets, forcing air into systems until a uniform gauge pressure of 5 psi or sufficient pressure to balance a column of mercury 10” high. Pressure shall be held without introduction of additional air for a period of at least 15 minutes.

D. All new and existing sanitary, waste and vent piping installed under the floor slab, in the area of work, shall be video camera scoped and recorded upon completion and prior to final acceptance. Any debris found in underground piping shall be flushed and removed as part of this contract. All video recordings and results shall be submitted to the Owner as part of the closeout documents.

E. Interior Water Piping System: Upon completion of water supply systems or section thereof, as required, system shall be tested and proved tight under a water pressure of 150 psi. Gauge shall be located on lowest new floor and pressure shall hold for a period of one (1) hours without introducing additional water. Water used for testing shall be from a potable source of supply.

F. Testing Summary:

1. W&V – with water to a 10 foot head for 30 minutes.
2. Water – with potable water to 150 psi for one hour.

G. Defective Work: If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. Repairs to piping shall be made with new material. No caulking or screwed joints or holes shall be acceptable.

H. Additional Tests:

1. Provide additional tests such as smoke pressure tests as required by regulations or as directed by Authorities making the inspection.
2. Provide for any repeated test as directed by the Architect, to make all systems tight as required.
3. Visual inspections of joints and valves shall be made as directed by the Architect.

END OF SECTION 22 00 00

SECTION 23 00 00 – HVAC TABLE OF CONTENTS

SECTION 23 00 00 – HVAC

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS AND REFERENCES

A. Include “General Requirements” and applicable parts of Division 1 as part of this section.

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. Where paragraphs of this section conflict with similar paragraphs of Division 1, requirements of this section shall prevail.

C. Coordinate work with that of all other trades affecting, or affected by work of this section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. The HVAC Subcontractor shall be responsible for filing all documents, payment of all fees, and securing of all inspections and approvals necessary for the work of this section.

1.2 DEFINITIONS

A. As used in this section, “provide” means “furnish and install”, “POS” means “Provided Under Other Sections” and “HVAC” means “Heating, Ventilating and Air Conditioning”.

B. As used in the Drawings and Specifications for Mechanical Work, certain non-technical words shall be understood to have specific meanings as follows, regardless of indications to the contrary in the General Conditions of other documents governing the HVAC work.

1. “Furnish” means: Purchase and deliver to the project site complete with every necessary appurtenance and support, all as part of the HVAC work. Purchasing shall include payment of all sales taxes and other surcharges as may be required to assure that purchased item(s) are free of all liens, claims, or encumbrances.

2. “Install” means: Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the HVAC work.

3. “Provide” means: “Furnish” and “Install”.

4. “New” means: Manufactured within the past two (2) years and never before used.

C. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any HVAC item in the Drawings or Specifications for HVAC work carries with it the instruction to furnish, install and connect the item as part of the HVAC work, regardless of whether or not this instruction is explicitly stated.

D. It shall be understood that the Specifications and Drawings for HVAC work are complimentary and are to be taken together for a complete interpretation of the HVAC work except that indications on the Drawings, which refer to an individual element of work, take precedence over the Specifications where they conflict.

1.3 SCOPE

A. Perform work and provide material 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 a complete and fully functional installation.

B. Give notices, file plans, obtain permits and licenses, pay fees and back charges, and obtain necessary approvals from Authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

C. Work shall include, but shall not be limited to, the following:

1. Removal of existing system and installation of new system.
2. Patch existing wall and floor openings from removed HVAC system.
3. Special coordination of chases and plenums as specified in Paragraph 3.02 (SPECIAL RESPONSIBILITIES).
4. Hoisting and rigging required to complete the work of this Section.
5. Sleeves, inserts and hangers.
6. Flexible connections for pumps and other vibrating and rotating equipment.
7. Equipment bases and supports.
8. Vibration isolation.
9. Sheetmetal work.
10. Complete air distribution system including low and medium pressure ductwork, diffusers, registers, grilles, splitters, dampers, etc.
11. Insulation for duct and piping.
12. Rooftop heating and ventilating units and related equipment.
13. Condensate piping from chilled water coil drain pipes.
14. Electric cabinet heaters.
15. Pipe, duct, valve and equipment identification.
16. Instruction manuals and startup instructions.
17. Testing and balancing.
18. Cleaning.
19. Automatic temperature controls, variable air volume controls and other controls.

D. Work to be done under this section is shown on the following Drawings: M0-01, M0-02, MD1-00, MD1-01, M1-00, M1-01, M1-02, M2-00, M2-01.

E. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this Section. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observer. Site visit is particularly important because this is renovation work.

F. Before starting work in a particular area of the project, visit site and examine conditions under which work must be performed including preparatory work done under other Sections or Contracts or by Owner. Report conditions that might affect work adversely in writing through Contractor to Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing and preparatory work.

1.4 RELATED WORK UNDER OTHER SECTIONS

A. The following items are not included in this section and will be performed under the designated sections.

1. Excavation and backfill.
2. Concrete work, including concrete housekeeping pads and other pads and blocks for vibrating and rotating equipment.

3. Cutting and patching of masonry, concrete, tile and other parts of structure, with the exception of drilling for hangers and providing holes and openings in metal decks.
4. Flashing of rooftop HVAC units, and of ductwork and all roof penetrations.
5. Installation of access panels in floor, wall, furred space, or above ceiling.
6. Painting, except as specified herein.
7. Electric power wiring for all equipment.
8. Structural supports necessary to distribute loading from equipment to roof or floor except as specified herein.
9. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing.
10. Outdoor air intake or exhaust louvers.
11. Gypsum drywall enclosures of supply and return ductwork on all rooftop air handlers, supply and return airshafts, as shown on Drawings.
12. Finish carpentry and millwork.
13. Fire protection.
14. Plumbing.
15. Electrical.

1.5 REGULATORY REQUIREMENTS

A. Perform work strictly as required by rules, regulations, standards, codes, ordinances and laws of Local, State and Federal governments, and all other Authorities that have legal jurisdiction over the site. Materials and equipment shall be manufacturer installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:

1. Local and State Building, Plumbing, Mechanical, Electrical, Fire and Health Department Codes.
2. American Gas Association (AGA).
3. National Fire Protection Association (NFPA).
4. American Insurance Association (A.I.A.) (formerly National Board of Fire Underwriters).
5. Occupational Safety and Health Act (OSHA).
6. Underwriters' Laboratories (UL).

B. Material and equipment shall be listed by Underwriters' Laboratories (UL), and approved by ASME and AGA for intended service.

C. When requirements cited in this Specification conflict with each other or with Contract Documents the most stringent shall govern work. The Architect may relax this requirement when such relaxation does not violate the rulings of Authorities that have jurisdiction. Approval for such relaxation shall be obtained in writing.

D. Most recent editions of applicable Specifications and publications of the following organizations shall form part of the Contract Documents.

1. American National Standards Institute (ANSI).
2. American Society of Mechanical Engineers (ASME).
3. National Electric Manufacturers Association (NEMA).

4. American Society for Testing and Materials (ASTM).
5. American Water Works Association (AWWA).
6. American Society for Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
7. Air Moving and Conditioning Association (AMCA).
8. Sheetmetal and Air Conditioning Contractors National Association (SMACNA).
9. Air Conditioning and Refrigeration Institute (ARI).
10. Thermal Insulation Manufacturers Association (TIMA).

1.6 SUBMITTALS

A. This section shall supplement Division 1.

B. Definitions:

1. Shop Drawings: Information prepared by the Contractor to illustrate portions of the work in more detail than shown in the Contract Documents.
2. Coordination Drawings: Detailed, large-scale layout Shop Drawings showing HVAC, Electrical, Plumbing and Fire Protection work superimposed to identify conflicts and ensure inter-coordination of Mechanical, Electrical, Architectural, Structural and other work.
3. Manufacturer's Product Data: Information prepared by the manufacturer which depicts standard equipment.

C. Submittals Procedures and Format:

1. Review submittal packages for compliance with Contract Documents and then submit to Architect and Engineer for review. Submittal packages shall be sent electronically, either emailed or through utilization of a web based construction administration application such as Procore or Submittal Exchange. All reviews will be returned in kind, either by email or through the web based application with a cover sheet and applicable submittal notations per below.
2. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:
    a. Title.
    b. Name and location of project.
    c. Names of Architect, Engineer, Contractor and Subcontractor(s).
    d. Names of Manufacturer, Supplier, Vendor, etc.
    e. Date of submittal.
    f. Whether original submittal or resubmitted.
3. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be ¼" = 1'-0" and shall indicate work of other Sections where physical clearances are critical and where interferences are possible. Provide larger scale details as necessary. Sheetmetal Drawings shall show elements of Architect's reflected ceiling plan, exposed ductwork, walls, partitions, diffusers, registers, grilles, fire dampers, sleeves and other aspects of construction as necessary for coordination.

D. Acceptable Manufacturers:

1. The Architect's Mechanical/Electrical design for each project is based on the single manufacturer listed in the schedule or shown on the Drawings. In Division 15 of these Specifications certain "Alternate Manufacturers" are listed 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.

b. Have identical operating characteristics to those called for in the Specifications.

c. Fit within the available space it was designed for, including space for maintenance and component removal, with no modifications to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the Contract Documents. The fact that a manufacturer's name appears as acceptable shall not be taken to mean the Architect has determined that the manufacturer's products will fit within the available space. This determination is solely the responsibility of the Contractor.

d. For equipment mounted in areas where structural matters are a consideration, the products must have a weight no greater than the product listed in the schedules or Specifications.

e. Products must adhere to all architectural considerations including, but not limited to, being the same size and of the same physical appearance as scheduled or specified products.

E. Substitutions: Substitution of products by manufacturers other than those listed shall only be done in accordance with subparagraph "F" "Substitutions and Deviations".

F. Substitutions and Deviations:

1. Deviations from the Contract Documents and the substitution of materials or equipment relative to the "Acceptable Manufacturers" referred to above, 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 substitution or deviation to the attention of the Architect. The letter shall describe changes in the system shown and physical characteristics (connections to adjacent materials, electrical services, service access requirements, and other characteristics), and differences in operating characteristics or cycles.

2. Without letters flagging the substitution or deviation to the Architect, it is possible that the Architect may not notice such substitution or deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Architect, the Contractor shall hold the Architect and his consultants harmless for any and all adverse consequences resulting from the deviations being implemented. Adverse consequences shall include, but not be limited to, excessive noise, excessive maintenance, shortened longevity, spatial coordination problems, and inadequate performance versus scheduled design. This shall apply regardless of whether the Architect has reviewed or approved Shop Drawings containing the deviation, and will be strictly enforced.

3. Do not request substitute materials or equipment unless identical material or equipment has been operated successfully for at least three (3) consecutive years. Such materials and equipment shall be a regular cataloged item shown in the current catalog of the manufacturer. When deviation or substitution is permitted, coordinate fully with related changes to Architectural, Structural, Plumbing, Fire Protection, Mechanical, and other work. Ensure that related changes necessary for coordination of substituted items are made within the Contract Price. Assume full responsibility for safety, operation and performance of the altered system.

4. Substitutions of equipment, systems, etc. requiring approval of local Authorities must comply with such regulations and be filed by the Contractor (should filing be necessary).

5. Consideration will not be given to claims that the substituted item meets the performance requirements with lesser construction. Performance, as delineated in schedules and in the Specifications, shall be interpreted as minimum performance.

6. Approval of proposed deviations or substitutions, if any, will be made at discretion of Architect.
7. If equipment is proposed for substitution that is not tested and rated according to industry-wide standards, the Architect shall have the right to have performance tests completed, at the Contractor's expense, to confirm the manufacturer's performance claims.

G. Submittal Notations: will be returned from the Architect marked as illustrated below:

□ NO EXCEPTION TAKEN	□ ACCEPTED AS NOTED
□ NOT ACCEPTED	□ REVISE AND RESUBMIT

1. Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the Drawings and Specifications. Contractor is responsible for dimensions which shall be confirmed and correlated at the job site; fabrication process and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.

H. Schedule: Incorporate the Shop Drawing review period into the construction schedule so that work is not delayed. Contractor shall assume full responsibility for delays caused by not incorporating the following Shop Drawing review time requirements into his project schedule. Allow at least ten (10) working days, exclusive of transmittal time, for review each time a Shop Drawing is submitted or resubmitted with the exception that fifteen (15) working days, exclusive of transmittal time, are required for the following:

1. Automatic temperature controls.
2. Coordination Drawings, if required by this Specification.
3. If more than five (5) Shop Drawings of this trade are received in one (1) calendar week.

I. List of Proposed Equipment and Materials: Within four (4) weeks after Award of Contract and before ordering materials or equipment, submit a complete list of proposed materials and equipment and indicate manufacturer's names and addresses. No consideration will be given to partial lists submitted out of sequence.

J. Responsibility:

1. The intent of submittal review is to check for capacity, rating, and certain construction features. Contractor shall ensure that work meets requirements of the 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 submittals marked "REVIEWED" to extent that they agree with the 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 the Contract Documents. The Architect's noting of some errors while overlooking others will not excuse the Contractor for proceeding in error. Contract Document requirements are not limited, waived, nor superseded in any way by review.
2. Inform Subcontractors, Manufacturers, Suppliers, etc. of scope and limited nature of review process and enforce compliance with the Contract Documents.

K. Material and equipment requiring Shop Drawing and/or Manufacturer's Data Submittals shall include but not be limited to:

1. DOAS Unit.

2. VRF System.
3. Diffusers, registers, grilles, splitters, dampers and accessories.
4. Filters.
5. Electric cabinet heaters.
6. Automatic controls.
7. Insulation and acoustical lining.
8. Vibration isolation.
9. Pipes, pipe hangers, sleeves and inserts.
10. Equipment bases and supports.
11. Unit heaters.
12. Identification for pipe, duct and equipment.
13. Complete ductwork Shop Drawings, construction details and duct construction standards.
14. Access panels.
15. Color selection charts and samples for equipment and systems in finished areas.

1.7 SURVEYS AND MEASUREMENTS

A. Base all required measurements, both horizontal and vertical, on reference points established by the General Contractor and be responsible for the correct laying out of the Mechanical work. In the event of a discrepancy between actual measurements and those indicated, notify the General Contractor in writing. Do not proceed with the work required until written instructions have been issued by the General Contractor.

1.8 COORDINATION

A. HVAC, Plumbing, Fire Protection, and Electrical Drawings are diagrammatic. They indicate general arrangements of Mechanical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with Structural and other trades and to meet Architectural requirements.

B. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow speedy and efficient completion of the work.

C. Furnish to other trades advance information on locations and sizes of all frames, boxes, sleeves and openings needed for their work. Furnish information and Shop Drawings necessary to allow trades affected by the work to install their work properly and without delay.

D. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated, request information from Architect. Where the HVAC work shall interfere with the work of other trades, assist in coordinating the space conditions to make satisfactory adjustments before installation. Without extra cost to the Owner, make reasonable modifications to the work as required by normal Structural interferences. The Mechanical Contractor shall be liable for any additional openings, or relocating and/or enlarging existing openings through concrete floors, walls, beams and roof required for any work which was not properly coordinated. Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside of structure as possible.

E. If any HVAC 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 trades involved without extra cost to the Owner.

F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

G. Protect all materials and work of other trades from damage which may be caused by the Mechanical work, and repair all damages without extra cost to the Owners.

1.9 MECHANICAL AND ELECTRICAL COORDINATION

A. The HVAC Subcontractor shall furnish and install various electrical items relating to the heating and ventilating equipment and control apparatus. The Electrical Subcontractor shall be required to connect power wiring to this equipment unless noted otherwise.

B. The HVAC and Electrical Subcontractors shall coordinate their respective portions of the work, as well as the electrical characteristics of the heating, ventilating and air conditioning equipment.

C. All power wiring and local disconnect switches will be provided by the Electrical Subcontractor for the line voltage power. All control and interlocking wiring shall be the responsibility of the HVAC Subcontractor.

D. 120V and above power wiring sources extended and connected to HVAC control panels, transformers and switches shall be the responsibility of the Electrical Subcontractor. All low voltage thermostats and any switch wiring shall be the responsibility of the HVAC Subcontractor.

E. Temperature control and equipment wiring shall be installed by the HVAC Subcontractor.

F. The Electrical Subcontractor will provide all magnetic starters except those furnished as an integral part of packaged equipment.

1.10 INSTALLATION REQUIREMENTS

A. The arrangement of all HVAC work shown on the Drawings is diagrammatic only and indicates the minimum requirements of the work. Conditions at the building including actual measurements shall determine the details of the installation. All work shall be laid out and installed so as to require the least amount of cutting and patching.

B. Review the Architectural Drawings and Specifications before ordering any material and equipment. Any discrepancies shall be brought to the attention of the Architect for his determination prior to proceeding with the work.

1.11 TYPICAL DETAILS

A. Typical details where shown on the Drawings shall apply to each and every item of the project where such items are applicable. They are not repeated in full on the Drawings, which in many cases are diagrammatic only, but with the intention that such details shall be incorporated in full. Any alternate method proposed for use by the Contractor shall have the prior approval of the Architect.

1.12 SLEEVES, INSERTS

A. Furnish and install all sleeves, inserts, anchor bolts and similar items to be set into masonry or concrete, as required for mechanical work. Internal diameter of sleeve ball shall be 1/2" larger than the outside diameter of the pipe or insulation covered line passing through it.

1.13 CORING, DRILLING

A. Core, cut and/or drill all small holes 4.5” diameter or less in walls and floors required for the installation of sleeves and supports for the Mechanical Electrical work.

1.14 ACCESSIBILITY

A. Install all work such that parts requiring periodic inspection, operation, maintenance and repair

are readily accessible.

B. Furnish all access panels appropriate to particular conditions, to be installed by trades having responsibility for the construction of actual walls, floors or ceilings at required locations.

1.15 SUPPLEMENTARY SUPPORTING STEEL

A. Provide all supplementary (non-structural) steelwork required for mounting or supporting equipment and materials.

B. Steelwork shall be firmly connected to building construction as required. Locations and methods of attachment shall be approved by the Architect.

C. Steelwork shall be of sufficient strength to allow only minimum deflection in conformity with manufacturer's published requirements.

D. All supplementary steelwork shall be installed in a neat and workmanlike manner parallel to floor, wall and ceiling construction: all turns shall be made at forty-five and ninety degrees, and/or as dictated by construction and installation conditions.

E. All manufactured steel parts and fittings shall be galvanized.

1.16 TOOLS AND EQUIPMENT

A. Provide all tools and equipment required for the fabrication and installation of the mechanical equipment at the site.

1.17 PORTABLE AND DETACHABLE PARTS

A. Contractors shall retain in their possession all portable and/or detachable parts and portions of materials, devices, equipment, etc. necessary for the proper operation and maintenance of the Mechanical and Electrical systems until final completion of the work, at which time they shall be handed over to the Owners.

1.18 RIGGING REQUIREMENTS

A. The work to be done under this Section of the Specifications shall include all hoisting, scaffolding and planking including the furnishing, set-up and maintenance of all derricks, hoisting machinery, cranes, helicopters, scaffolds, staging and planking as required for the work.

B. Provide installation and erection information including; lifting requirements, and any special rigging or installation requirements for all equipment under the submittals.

1.19 RECORD DRAWINGS, PROJECT CLOSEOUT

A. As work progresses and for the duration of Contract, maintain a complete and separate set of prints of Contract Drawings at job site at all times. Record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to the original design. Work shall be updated on a weekly basis and shall be made available for review by Architect. Failure to perform this work shall be reason for withholding requisition payments. In addition, take photographs of all concealed equipment in gypsum board ceilings, shafts, and other concealed, inaccessible work. At completion of work, make copies of photographs with written explanation on back. These shall become part of Record Documents.

B. At the completion of work, prepare a complete set of Record Drawings showing all systems as actually installed. The copies will be made available for the HVAC Contractor's copying, at his expense, to serve as backgrounds for the Record Drawings. The quantity of copies which are made available shall in no way be interpreted as setting a limit to the number of Drawings necessary to show the required information. The HVAC Contractor's professional Draft Person shall transfer changes to electronic CAD files. Submit three (3) sets of electronic copies to

Architect for comments as to compliance with this section.

C. The Architect will not certify the accuracy of the Record Drawings. This is the sole responsibility of the Mechanical Contractor.

D. This trade shall submit the Record Drawings for approval by the Fire and Building Departments in a form acceptable to the departments, when required by the jurisdiction.

E. Record Drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer, make and model numbers of final equipment installation.

1.20 GUARANTEE/WARRANTY

A. Guarantee and 24 hour service.

1. Guarantee Work of this Section in writing for not less than one (1) year following the date of acceptance by the Owner. If the equipment is used for temporary heat, cooling, etc, prior to acceptance by the Owner, the bid price shall include an extended period of warranty covering the one (1) year of occupancy, starting from the date of acceptance by the Owner. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to the Architect's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

2. In addition to guarantee requirements of Division 1 and of Subparagraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.

3. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the warranty period, the affected part or parts shall be replaced by this Contractor without any reimbursement.

4. Replace material and equipment that require excessive service during guarantee period as defined and as directed by Architect.

5. Provide 24 hour service beginning on the date the project is accepted by the Owner, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at no cost to the Owner. Service can be provided by this Contractor or a separate service organization. Choice of service organization shall be subject to Architect and Owner approval. Submit name and a phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

6. Submit copies of equipment and material warranties to Architect before final payment.

7. At end of guarantee period, transfer manufacturer's equipment and material warranties still in force to Owner.

8. This paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.

9. PART 2 paragraphs of this Specification may specify warranty requirements that exceed those of this paragraph. Those paragraphs shall govern.

10. Use of systems provided under this Section for temporary services and facilities shall not constitute Final Acceptance of Work by Owner, and shall not initiate the guarantee period.

11. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise the Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. The Architect and/or Engineer will direct course of action.

1.21 OPERATING, INSTRUCTION AND MAINTENANCE MANUALS

A. Obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items. Assemble literature in coordinated manuals with additional information describing combined operation of field-assembled units, including as-built wiring diagrams. The manual shall contain the names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment. Divide manuals into three sections or books as follows:

1. Directions for and sequence of operation of each item of HVAC system, e.g. air handling units. Sequence shall list valves, switches and other devices used to start, stop and control system. Detail procedure to be followed in case of malfunctions. Include detailed approved flow diagrams of temperature control, heating, condensate, etc. as appropriate for systems provided. Include approved valve directory showing each valve number, location of each valve and equipment or fixture controlled by valve.

2. Detailed maintenance and troubleshooting manuals containing data furnished by manufacturer for complete maintenance. Include copy of balancing report.

3. Lubrication instructions detailing type of lubricant, amount and intervals recommended by manufacturer for each item of equipment. Include additional instructions necessary for implementation of first class lubrication program. Include approved summary of lubrication instructions in chart form, where appropriate.

B. Furnish three copies of manuals to the Architect for approval and distribution to the Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit the Owner's personnel to become familiar with equipment and operation prior to acceptance.

C. Provide framed and glazed charts as follows: mount as directed by the Architect.

1. Lubrication chart from third part of manual.

D. Operating Instructions: Upon completion of installation or when the Owner accepts portions of building and equipment for operational use, instruct the Owner's operating personnel in any or all parts of the various systems. Instructions shall be performed by factory authorized personnel. The Owner shall determine which systems require additional instructions. The duration of instructions shall take equipment through complete cycle of operation (at least five working days). Make adjustments under operating conditions.

E. Each contractor shall be responsible for his 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.

F. Each separate contractor shall protect the work and material of other trades that might be damaged by his work or workmen and make good all damage thus caused.

1.22 SERVICE CHARACTERISTICS

A. All equipment and wiring shall be suitable for the applied voltage.

B. All motors rated 1/2 horsepower and above shall be 208V or 480V, 3-phase.

1.23 QUALITY ASSURANCE

A. The requirements of the State Building Code and Local regulations establish the minimum acceptable quality of workmanship and materials, and all work shall conform thereto unless more stringent requirements are indicated or specified herein.

B. All work shall comply with the latest editions of the codes as referenced herein.

C. Follow manufacturer's directions for articles furnished, in addition to directions shown on

Drawings or specified herein.

D. Protect all work, materials, and equipment from damage during process of work. Replace all damaged or defective work, materials and equipment without additional cost to the Owner.

E. All equipment and materials for permanent installation shall be the products of recognized manufacturers and shall be new.

F. Equipment and materials shall:

1. Where normally subject to Underwriters Laboratory Inc. listing or labeling services, be so listed and labeled.
2. Be without blemish or defect.
3. Not be used for temporary purposes.
4. Be in accordance with the latest applicable ASHRAE standards.

G. Purchase products which will meet with the acceptance of all Authorities Having Jurisdiction over the work. Where such acceptance is contingent upon having the products examined, tested and certified by Underwriters or other recognized testing laboratory, the product shall be so examined, tested and certified.

H. Except for plans, all items of equipment or material of one generic type shall be the product of one manufacturer throughout.

I. For items which are to be installed but not purchased as part of the HVAC work, the Mechanical Contractor work shall include:

1. The coordination of their delivery.
2. Their unloading from delivery trucks driven into any point on the property line at grade level.
3. Their safe handling and field storage until the time of permanent placement in the project.
4. The correction of any damage, defacement or corrosion to which they may have been subjected. Replacement, if necessary, shall be coordinated with the Contractor who originally purchased the item.
5. Field erection and internal wiring as necessary for their proper operation.
6. Mounting in place, including the purchase and installation of all dunnage, supporting members, and fastenings, necessary to adapt them to architectural and structural conditions.

J. Items which are to be installed, but not purchased as part of the HVAC work shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the HVAC work will be considered only if presented in writing within one (1) week of the date of delivery to the project of the items in question. The mechanical work includes all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

1.24 DELIVERY, STORAGE AND HANDLING

A. All materials for the work of this section shall be delivered, stored and handled so as to preclude damage of any nature. Manufactured materials shall be delivered and stored in their original containers, plainly marked with the products' and manufacturer's name. Materials in broken containers or in packages showing watermarks or other evidence of damage shall not be used and shall be removed from the site.

PART 2 – PRODUCTS

2.1 DUCTWORK AND AIR DISTRIBUTION EQUIPMENT

A. Reference Standards:

1. Material, construction and installation shall meet requirements of most recent editions of the following standards and references, except for more stringent requirements specified or shown on the Drawings:

Standard	As Applicable To
SMACNA HVAC Duct Construction Standards Metal and Flexible	Sheetmetal Ductwork; Duct Liners; Adhesives; Fasteners; Flexible Ductwork
SMACNA HVAC Air Duct Leakage Test Manual	Duct Leakage Testing
SMACNA Fibrous Glass Duct Construction Standards	Fibrous Glass Ductwork; Tapes
SMACNA Ducted Electric Heat Guide for Air Handling Systems	Electric Duct Heaters
SMACNA Thermoplastic Duct (PVC) Construction Manual	PVC Ductwork
ADC and TIMA Flexible Duct Performance Standards	Flexible Ductwork
NFPA 90A	Fire Dampers; Fire Resistance Standards for Ducts and Liners
NFPA 96	Kitchen Hood Exhaust Ductwork
NFPA 45	Laboratories using chemicals
SMACNA Guidelines for Welding Sheetmetal	Welded Galvanized, Black Iron and Stainless Ductwork

B. General:

1. Provide supporting and hanging devices necessary to install the entire HVAC system including ductwork and equipment, and to prevent vibration.
2. Provide vertical and horizontal supports as required by code to meet minimum applicable earthquake resistance standards.
3. Ductwork shall be free from vibration under all conditions of operation. Dimensions shown on the Drawings for lined ductwork are net inside dimensions. Increase ductwork dimensions to accommodate lining requirements.
4. Pipe or conduit crossing duct: No pipe, conduit, hanger, Architectural element nor structural member shall pass through ductwork.
5. When making offsets and transformations necessary to accommodate structural conditions, preserve full cross-sectional area of the ductwork as shown on the Drawings.
6. Ductwork shall have pressure-velocity classifications as follows:

Duct Construction Class	Static Pressure Rating	Pressure	SMACNA Seal Class	SMACNA Leakage Class	Velocity
2”	2”	Pos. or Neg.	B	12	2500 fpm or less
1”	1”	Pos. or Neg.	B	12	2500 fpm or less
1/2”	1/2”	Pos. or Neg.	B	12	2000 fpm or less

   a. For negative pressures over 3” w.g., refer to SMACNA Round and Rectangular Industrial Duct Construction Standards for joint and intermediate reinforcement requirements

7. Sealing requirements for Class B, Leakage Class 12, galvanized, non-welded, aluminum or non-welded stainless steel ductwork:

a. Transverse Joints:

1) During assembly seal all flanged transverse joints with sealing tape of quality equal to Hardcast Inc. Model 1902-FR. Corners shall be sealed as described by SMACNA and when applicable per manufacturer's published procedures.

2) Seal all non-flanged transverse joints with Hardcast Inc. Versa Grip Model 102 or approved equal.

b. Longitudinal Seams: Seal all longitudinal seams during ductwork fabrication with Hardcast Inc. Cold Seal Model 1001 or approved equal.

8. Support:

a. Space hangers as required by SMACNA (8 ft. max.) for horizontal duct on 8 ft. centers, unless concentrated loadings require closer spacing.

b. Support vertical duct on each floor or slab it penetrates.

c. Supports for ductwork and equipment shall be galvanized unless specified otherwise.

9. Connections:

a. Connect inlets and outlets of air handling units and fans to ductwork with flexible connections unless fan has vibration isolator mounts inside unit with flexible connections and no external vibration isolators. Exception: Do not use flex on life safety smoke exhaust fans.

b. Indoors, flexible connections shall be neoprene-coated fibrous glass fire retardant fabric, by Ventifabrics, or Durodyne. Outdoors, flexible connections shall be DuPont hyplon-coated fibrous glass fire, weather and UV-resistant by Ventifabrics or Durodyne.

c. Secure flexible connections tightly to air handlers with metal bands. Bands shall be same material as duct construction.

d. Connections from trunk to branch duct shall be as detailed on Drawings.

10. Construction:

a. No sharp metal edges shall extend into air streams.

b. Install drive slips on air-leaving side of duct with sheetmetal screws on 6" centers.

c. Spin in collars shall NOT be used for branch connections in 3" or higher pressure class ductwork.

11. Joints:

a. Longitudinal lock seams shall be double-locked and flattened to make tight joints.

b. Make transverse joints, field connections, collar attachments and flexible connections to ducts and equipment with sheetmetal screws or bolts and nuts. Do not use rivets or staples.

12. Prefabricated Transverse Duct Joints:

a. Transverse joints in galvanized sheetmetal ductwork may be made with galvanized gasketed frame and angle duct systems by Ductmate, TDF, TDC or approved equal. Angles shall be at least 20 gauge. Prefabricated transverse duct joints shall not be used for duct 16 ga. and heavier, nor for duct 23 ga. and lighter.

b. Secure angles to duct with screws (using clutched arbor) or spot-welds spaced as recommended by manufacturer for duct pressure class.

13. Elbows and Bends:

a. Elbows and bends for rectangular ducts shall have centerline radius of 1-1/2 times duct width wherever possible. Elbows for grease exhaust and fume hood exhaust shall be full radius. Vanes or mitered duct are not allowed.

b. Where centerline radius is less than 1-1/2 times duct width (on supply, return and exhaust ductwork), elbows shall be radius throat (square throat allowed when turning around column or other close objects) with radius heel. For elbows whose width is greater than 48 inches and/or where shown on plans, provide splitter vanes. Install vanes in accordance with SMACNA. Where multiple elbows are separated by less than ten duct diameters use splitter (full length) vanes.

c. For round ductwork provide stamped elbows, with centerline radii equal to 1-1/2 times duct diameter, or gored elbows as follows:

Elbow Angle	No. of Gores
0° - 36°	2
37° - 72°	3
73° - 90°	5

d. Elbows for flat oval ducts shall have centerline radii equal to 1-1/2 times duct diameter in plane of bend, or gored elbows with gores as specified for round ducts.

14. Access Panels/Doors:

a. Provide proper pressure and leakage rated, gasketed, duct mounted access panels/doors for the following items with minimum sizes, as indicated. Access doors shall be of double wall construction. Access doors in insulated ducts shall be insulated. Gauges of door materials, number of hinges, number and type of door locks shall be as required by the SMACNA Duct Construction Standards. Hinged doors are not acceptable, screwed or bolted access panels are not acceptable. Doors shall be chained to frame with a minimum length of 6” to prevent loss of door. For seal Class A, access doors shall be leakage rated, neoprene gasketed UL 94 HF1 listed, DUCTMATE “sandwich” or approved equal. Door metal shall be the same gauge as the attached duct material. For grease and high temperature ducts, door assembly shall be rated for 2300° F. The minimum sizes shall be:

1) Fire dampers – 12” x 12”, or larger.

2) Combination Fire/Smoke dampers – 12” x 12”, or larger.

3) Smoke dampers – 6” x 6” minimum.

4) Automatic control dampers – 6” x 6” minimum.

5) Manual volume dampers 2 sq. ft. and larger – 6” x 6” minimum.

6) Inlet side to all coils – 12” x 12”, or larger.

7) Suction and discharge sides of inline fans – 24” x 24” minimum

8) At additional locations indicated on Drawings, or specified elsewhere – 12” x 12” minimum.

9) Generally access doors are not shown on the Drawings, but shall be provided in accordance with the above.

15. Extractors shall have adjusting rod and locknut on outside of duct.

16. Duct Pressure Tests:

a. Pressure test ducts after takeoffs and wall penetrations are in place and before applying exterior insulation. Correct any leaks.

b. Pressure and leak test 100% of medium and low-pressure ductwork at 100% of operating

system pressure. Duct shall be constructed so there is no joint or structural failure at the test pressure.

17. Materials:

    a. Sheetmetal ducts shall be constructed of hot-dipped galvanized sheetmetal with G90 Commercial coating according to ASTM 527 unless specified otherwise.

    b. Flexible Ductwork:

        1) Flexible ductwork, connecting to un-insulated or unlined duct, shall be polyester core with corrosion-resistant helical wire reinforcing. The polyester core shall be minimum two-ply and shall have a minimum thickness of 0.0017". Flex duct shall be UL rated for 6" WC positive pressure, 2" WC negative pressure with a maximum velocity of 4000 FPM. Flexduct must be listed as a Class 1 Connector according to UL 181 and shall meet the requirements of NFPA 90A. The maximum ASTM E-84 fire-hazard rating shall be 25 flame spread, 50 fuel contributed and 50 smoke developed. Un-insulated flexible duct shall be equivalent to Wiremold, Type WB, or Flexmaster Types 2 and 4 (not type 9).

        2) Flexible duct connected to insulated or lined duct shall also be insulated and shall be equivalent to Wiremold Type WK or Flexmaster Types 2 or 4 (not type 9), with 1-1/2" 3/4 lb. density fiberglass insulation and an aluminized reinforced vapor barrier.

        3) Submittals shall include data or number of polyester plies and minimum thickness of polyester core, in addition to other data listed above required to ensure that submitted product meets the requirements of these Specifications.

        4) If flex duct other than the model numbers of the vendors listed above is submitted, a sample of the flex duct shall be submitted to the Architect. The Architect shall have sole discretion in determining whether the submitted flex duct is equivalent to that of the named vendors above.

        5) Unless otherwise indicated, flexible duct shall not exceed 5'-0" long.

C. 2" and Lower Pressure Class Ductwork – Rectangular:

    1. Ducts wider than 19" with more than 10 square feet of un-braced panel shall be beaded or cross-broken.

    2. Internal stiffening struts shall only be used upon prior written approval of the Architect.

    3. Make changes in duct size with tapered connections as required by SMACNA. Changes shall NOT exceed 30° from line of airflow. Take-off to the diffusers shall be 45° leading edge type or bellmouth type.

    4. Transverse joints shall be TDF/TDC or slip joints; use flat or standing seam according to SMACNA. Where the duct size requires a standing seam but space restrictions dictate flat seam, notify Architect prior to fabrication.

D. 2" and Lower Pressure Class Ductwork – Round:

    1. Joints:

        a. Longitudinal joints shall be spiral seam, butt welded, lap and seam welded, or ACME lock-grooved seam. Snap lock seams shall be used on 1/2" w.g. pressure class duct only.

        b. Transverse joints shall be beaded sleeve joint or other approved joints listed in SMACNA. Use three (3) or more sheetmetal screws at 15" uniform intervals along circumference of joints.

    2. Branch fittings shall be conical tee (Buckley or equal) or combination tee as shown in

SMACNA.

E. Flexible Duct:

1. Flexible ductwork shall be Flexmaster Triple-Lock Buck Duct Flexible Air Duct (insulated or non-insulated) as manufactured by Buckley Associates, ATCO, or equal. Flexible duct, non-insulated, shall be Underwriters Laboratory Listed UL 181 Class 0 air duct and constructed in accordance with NFPA Standards 90A and 90B. It shall have a smoke/flame spread rating of 50/25.
2. The duct shall be made from a tape of dead soft aluminum sheet, spiral wound into a tube and spiral corrugated to provide strength and stability. The joint shall consist of a triple lock mechanically performed without the use of adhesives to make a durable airtight seam. A double lock is not acceptable.
3. Flexible duct connected to insulated or lined duct shall also be insulated. Flexmaster insulated flex shall have a gray Fire Retardant Polyethylene outer jacket with a 1/2 lb. density, 1-1/2" thick fiberglass insulation blanket, factory wrapped, providing a thermal performance of R-6 overall. Flexible Duct, insulated, shall be Underwriters Laboratory Listed and constructed in accordance with NFPA Standards 90A and 90B. It shall have a smoke/flame spread rating of 50/25.
4. The flexible duct shall be supported per manufacturer's instructions.
5. Flexible ductwork shall be rated at 12" positive pressure. Flexible ductwork from 3" to 16" in diameter shall have a negative pressure rating of 12". Flexible ductwork 18" to 20" in diameter shall have a negative pressure rating of 8".
6. All flexible ductwork shall be individually boxed and labeled for delivery to the jobsite for maximum protection.
7. Submittals shall include data on minimum thickness of aluminum core, in addition to other data listed above required to ensure that submitted product meets the requirements of these Specifications.
8. Provide sealing compound for installation. See further paragraphs in this Specification and details for other installation requirements.
9. Flexible duct shall be limited to 5' length.

F. Volume Dampers:

1. Provide manually adjustable rectangular parallel blade dampers for duct heights less than 12" with factory-installed locking hand quadrants extended 2" for all dampers installed in externally insulated duct:
   a. On each supply, return and general duct take-off.
   b. At each take-off to register, grille or diffuser (not all are shown on Drawings for clarity).
2. Volume dampers shall be manufactured approximately 5/16" smaller in width and 1/8" smaller in height than size of duct in which they are installed; e.g., nominal damper size is 24" x 10"; actual size is approximately 23-11/16" x 9-7/8".
3. Volume damper frames shall be constructed of #6063 extruded aluminum reinforced channel with minimum thickness of 0.050". Opposed damper blades shall be #6063 extruded aluminum with minimum thickness of 0.050" and shall include reinforcing ribs. Each blade shall be supported in the damper frame by individual Teflon axle bearings, and shall be driven by stainless steel connecting slide linkage controlled by 3/8" square steel control shaft.
4. All required volume dampers may not be indicated on Drawings, but volume dampers shall be provided as necessary for systems balancing.
5. Dampers 12" and larger in height shall be opposed multi-blade type.

6. Where volume dampers are inaccessible, use locking type ceiling regulators and miter gear or worm gear for all horizontal dampers. Bearing coupling for bottom duct control may be used for shaft on vertical blade dampers. The 3/8” rod between ceiling regulator and damper shall be provided by Contractor.
7. Damper blades shall be two gauges heavier than adjoining ductwork, and shall be riveted to supporting rods. Hem over edges parallel to rods.
8. Brackets shall be galvanized metal, secured to ductwork with sheetmetal screw with locking quadrant arms (see Seal Class Section for additional requirements). Provide 2” handle extension for all dampers on externally insulated ductwork.
9. Note: All required volume dampers may not be indicated on Drawings but dampers shall be provided as necessary for system balancing.

G. Diffusers, Registers and Grilles:

1. Provide diffusers, registers and grilles for supply, return and exhaust outlets, of size, type and design shown on Drawings. Acceptable manufacturers shall be Anemostat, Krueger, Metal*Aire, Price, or Titus.
2. Equipment shall be tested and rated per ASHRAE 91-70.
3. Equipment shall handle air quantities at operating velocities:
   a. With maximum diffusion within space supplied or exhausted.
   b. Without objectionable air movement as determined by Architect.
   c. With sound pressure level not to exceed NC 30.
4. Supply, return and exhaust outlets shall have opposed blade volume dampers operable from front.
5. Supply registers shall have two (2) sets of directional control blades.
6. Diffusers within same room or area shall be of same type and style to provide Architectural uniformity.
7. Diffusers, registers and grilles shall be furnished with gaskets and installed with faces set level and plumb, tightly against mounting surface.
8. Finish shall be as directed by the Architect.
9. Coordinate diffusers, registers and grilles with ceiling and wall construction. Refer to Architectural Drawings for exact lengths and for framing and mitering arrangements that may differ from those shown on HVAC Drawings.

H. Branch Duct Take-off Fittings:

1. Contractor shall provide bellmouth take-offs at all branch duct locations.
2. Bellmouth fitting shall be provided with damper.
3. Bellmouths shall be constructed of heavy-duty galvanized steel. Bellmouths shall include an airtight neoprene gasket to ensure a tight fitting with minimal leakage. Pre-drilled holes shall be provided for quick mounting.
4. Standard damper hardware to be constructed of 26-gauge galvanized material with a quadrant damper and tight-fitting gasket to ensure minimal leakage at damper pivot points.
5. Optional heavy-duty hardware shall be provided at locations of higher static pressure where shown on the Drawings.
6. Ninety-degree (90°) take-offs are not permitted on this project.

2.2 ACOUSTICAL DUCT LINING

A. Provide 1” thick acoustical lining by Certain-teed, Knauf, Owens Corning or Manville for following ductwork:

1. Supply and return ductwork, including plenums for minimum of 20 feet from rooftop or air handling units (or to sound attenuator if attenuator is located further than 20 feet from fan). Exception: 3 feet before and 10 feet after humidifiers and dedicated life safety smoke exhaust systems.
2. Exhaust ductwork, including plenums, for minimum of 20 feet from fan inlet. Exceptions: kitchen hood, dishwasher and fume hood system.
3. Low-pressure duct downstream from variable and constant volume boxes.
4. Sound attenuation boots.
5. Other ductwork indicated as lined on Drawings.
6. Increase duct dimensions to accommodate lining while maintaining inside clear dimensions shown on the Drawings.
7. Lining shall be as follows:

Lining for	Material	Minimum NRC	Maximum K-Factor At 75° F Mean
Low-pressure ductwork (below 4” S.P.)	Black, Matfaced, 2 lb. density, flexible glass	0.75	0.24
Medium and high-pressure ductwork (above 4” S.P.)	Black, Matfaced, 3 lb. density, rigid board	0.75	0.23

8. Materials and installation shall meet following standards, as applicable:
   a. NFPA-90A, UL723, NFPA-255.
   b. SMACNA Duct Liner Applications Standard.
   c. SMACNA Mechanical Fasteners Standard.
   d. Adhesive and Sealant Council: Adhesives Standard for Duct Liner – ASC-A-7001A
   e. ASTM E-84 fire hazard classifications of 25 flame spread, 50 smoke developed and 50 fuel contributed.
9. Duct liner shall be installed without interruptions or gaps, using 100% coverage of adhesive and mechanical fasteners. Mechanical fasteners shall be welded or secured mechanically to duct on 12” maximum centers.
10. Cut liner to ensure overlapped and compressed longitudinal joints at corners. Transverse joints in liner shall abut precisely. Seal joints against fiber entrainment with approved adhesive, as recommended by manufacturer. Use sheetmetal nosing at beginning of lining (in direction of flow) to prevent erosion.
11. The Contractor shall ensure the integrity of acoustical lining when slip-in duct heaters are installed; loose lining shall not flap about in the airstream. Secure edges of lining with sheetmetal nosing, where liner is interrupted to make room for slip in heaters.
12. Submit samples and catalog data for duct liner, mechanical fasteners and adhesives to Architect for approval.
13. Friction coefficient correction factor at 1000 FPM shall be no greater than 1.1. Liner shall be Certain-teed Ultra Liner, Knauf Duct Liner M or Johns Manville Linacoustic. Other liners from these manufacturers with friction coefficient correction factors greater than listed above, are

not acceptable.

14. Mylar used for vapor barrier shall meet ASTM E-84 classification.
15. Any cut liner due to duct take-offs and branches shall be totally sealed at edges (with sheetmetal nose pieces) to prevent entrainment of loose fibers.
16. Do not insulate lined duct.

2.3 DUCT INSULATION:

A. General:

1. Insulation shall be Certain-Teed, Knauf, Manville or Owens Corning. Install insulation, mastics, adhesives, coatings, covers, weather-protection and other work exactly as required by manufacturer's recommendations. Materials shall meet requirements of Adhesive and Sealant Council Standards and SMACNA.
2. Apply insulation after systems have been tested, proved tight and approved by Architect. Remove dirt, scale, oil, rust and other foreign matter prior to installation of insulation.
3. Leaks in vapor barrier or voids in insulation will not be accepted.
4. ASTM E-84 minimum fire hazard ratings shall be 25 flame-spread, 50 fuel contributed and 50 smoke developed.
5. Where ducts are insulated, flexible connections to ducts shall be insulated.
6. Insulate standing seams with same material and thickness as duct.
7. Acoustically lined ductwork shall not be insulated externally, except as noted otherwise.
8. Return ductwork in ceiling plenums shall not be insulated.
9. Insulation shall be continuous through wall and ceiling openings and in sleeves.
10. Transmission rates of vapor barriers shall not exceed 0.02 perms.

B. Concealed Rectangular, Flat Oval and Circular Ductwork:

1. Insulate supply and outside air ductwork and plena in concealed spaces and return ductwork not in ceiling plenum with 2" thick glass duct wrap; with foil-Kraft flame-resistant vapor barrier.
2. Insulation shall provide a minimum R-6 value when located in unconditioned spaces and a minimum R-12 value when located outside the building.
3. If insulation does not have pre-cut lap, make lapped butt joints by cutting 2" strip of insulation away from vapor barrier. Apply 6" strips of approved adhesive on 16" centers and wrap duct with insulation. Staple lapped joint with outward-clinching staples. Seal stapled joints airtight with approved matching pressure-sensitive tape.
4. For rectangular duct 24" or larger in any dimension, augment application method specified in item 3 with approved mechanical fasteners, such as weld pins with speed washers, on 18" centers on bottom of duct.
5. Cover breaks in vapor material with patches of same material, secured with adhesive and staples. Seal staples with approved pressure sensitive tape.
6. Fill voids in insulation at jacket penetrations and seal with pressure sensitive tape.
7. Seal and flash terminations and punctures with fibrous glass cloth between two (2) coats of pressure sensitive tape.
8. Terminate vapor barrier and extend insulation at standoff brackets.

2.4 PIPING AND FITTINGS

A. General: Pipe materials and fitting materials shall be as indicated in Schedule of Pipe and Fitting Materials.

B. Schedule of Pipe and Pipe Fitting Materials:

Service	Systems Description	Pipe Size	Pipe Material	Joints	Fitting Material	Fitting Rating PSI/Class/ Weight
Condensate Drain	CD	All	PVC. Schedule 40 Note 2	Solvent Welded	PVC, Schedule 40	Class 150
Refrigerant	R	All	Copper, ACR	Silver Brazed	Wrought Copper	200 PSI

2.5 PIPE AND EQUIPMENT INSULATION

A. Insulation materials:

a. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.

1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a) Johns Manville; a Berkshire Hathaway company.

b) Knauf Insulation.

c) Manson Insulation Inc.

d) Owens Corning.

2) Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ or ASJ-SSL.

3) Fabricated shapes in accordance with ASTM C450 and ASTM C585.

4) Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

b. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. Rigid board shall have minimum density 6lb/cu.ft. Semi-rigid board shall have minimum density 2.5lb/cu.ft.

1) For applications in concealed locations and mechanical rooms, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2) For applications in exposed occupied space, provide insulation with factory-applied ASJ jacket for field painting. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

3) 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) CertainTeed; SAINT-GOBAIN.

b) Johns Manville; a Berkshire Hathaway company.

c) Knauf Insulation.

d) Manson Insulation Inc.

e) Owens Corning.

c. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I, for tubular materials, Type II for sheet materials.

1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a) Aeroflex USA.

b) Armacell LLC.

c) K-Flex USA.

d. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.

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) Owens Corning.

2) Preformed Pipe Insulation without Jacket: Type II, Class 1, unfaced.

3) Preformed Pipe Insulation with Jacket: Type II, Class 2, with factory-applied ASJ or ASJ-SSL jacket.

4) Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.

5) Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

B. Insulation conductivity and thickness per pipe size comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

C. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

D. Apply insulation after systems have been tested, proved tight and approved by the Architect. Remove dirt, scale, oil, rust and foreign matter prior to installation of insulation.

E. Dual temperature piping and equipment shall be insulated using the greater thickness of either Heating Hydronic Systems or Cooling Hydronic Systems tables below for the applicable pipe size.

F. Piping Insulation Table:

Refrigerant Piping Systems Insulation - Including: Refrigerant liquid and hot gas					
Insulation Conductivity (Btu in/h ft^2 °F)	Mean Rating Temp. (°F)	Insulation Type	Thickness by pipe size (inches) - Indoor	Thickness by pipe size (inches) - Outdoor	Field Applied Jacket
0.26	0	Flexible Elastomeric	All – 1	<4NPS - 2 ≥4NPS - 3	Indoor: PVC in mechanical rooms when <10 feet above floor Outdoor: Aluminum w/ Moisture Barrier

G. Refrigeration Line Insulation:

1. Installation shall meet manufacturer's recommendations. Seal butt joints with insulation manufacturers approved adhesive.
2. Outside above ground insulation shall be protected with two (2) coats of approved vinyl lacquer coating over woven glass mesh adhered to insulation with Insulcolor or approved equal lagging adhesive, as recommended by manufacturer.
3. Refrigerant piping in hung ceiling and under floor supply and return plena shall be insulated with insulation that meets applicable requirements of insulation table above.
4. VRF systems require all refrigerant lines to be insulated from the outdoor unit to the indoor terminal units.

2.6 VARIABLE REFRIGERANT FLOW (VRF) SYSTEMS

A. General:

1. VRF systems shall be sourced from a single manufacturer specializing in the technology with a minimum of 10 years' experience of installation of systems of the type described herein.
2. Basis of Design shall be Mitsubishi City Multi.
   a. Acceptable equals provided they meet the full intent of the design scheme and can provide the required heating and cooling delivery at the specified design temperatures:
      1) Mitsubishi
      2) Carrier
      3) Daikin
      4) Others: no others will be accepted.

B. SYSTEM DESCRIPTION R2-SERIES (SIMULTANEOUS HEAT/COOL)

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 Daikin, 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.

C. SYSTEM DESCRIPTION Y-SERIES RAPID CHANGEOVER

1. Per the equipment schedule, the variable capacity, heat pump or heat recovery air conditioning system basis of design is Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system(s). In order to maintain optimal tenant comfort during periods when both heating and cooling may be desired, systems must be capable of heat recovery (simultaneous heating and cooling) operation or rapid changeover. Rapid changeover option allows automatic and alternating mode switching between heating and cooling mode during owner-defined and adjustable ambient temperature ranges. Changeover sequences such as weighted voting—or similar sequences which might result in more than a one hour delay for the desired heating or cooling during the owner-defined shoulder seasons—are not allowed.
2. Acceptable alternative manufacturers, assuming compliance with these equipment specifications, are Daikin, 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.

D. QUALITY ASSURANCE

1. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.
2. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
3. 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).
4. 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.
5. 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.

E. DELIVERY, STORAGE AND HANDLING

1. Unit shall be stored and handled according to the manufacturer’s recommendation.

F. 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. Manufacturer shall have a minimum of fifteen (15) years continuous experience providing VRF systems in the U.S. market.
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.

G. OUTDOOR UNITS

1. R2-SERIES HIGH EFFICIENCY (HEAT RECOVERY), AIR COOLED OUTDOOR UNITS
   a. General:
      1) 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.
      2) 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.
      3) 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.
      4) Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.
      5) The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.
      6) 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.
      7) The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
      8) 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.

9) The outdoor unit shall be capable of operating in heating mode down to -25F ambient temperatures or cooling mode down to 23F ambient temperatures, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.

10) 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.

11) 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.

12) 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.

13) In reverse defrost all refrigerant shall be bypassed in the main branch controller and shall not be sent out to the indoor units, systems that flow refrigerant through indoor units during reverse defrost shall not be allowed.

14) The outdoor unit shall be capable of operating in cooling mode down to -10□F with optional manufacturer supplied low ambient kit.

15) Low ambient kit shall be provided with predesigned control box rated for outdoor installation and capable of controlling kit operation automatically in all outdoor unit operation modes.

16) Low ambient kit shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

17) Low ambient kit shall be factory tested in low ambient temperature chamber to ensure operation. Factory performance testing data shall be available when requested.

18) 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.

19) VRF four-legged outdoor unit mounting systems shall be provided by manufacturer. Stand shall be made from 7 gauge plate steel with thermally fused polyester powder coat finish that meets ASTM D3451-06 standards. Stands shall be provided with galvanized mounting hardware and meets all ASCE 7 overturning safety requirement.

2. Unit Cabinet:

   a. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

   b. Outdoor unit components shall be coated with the Seacoast Protection Coating (Brine Spray – BS coating) to protect components from premature corrosion due to a seacoast environment. Coating shall be applied to components before original outdoor unit

assembly to ensure manufacturer quality standards are not compromised and shall meet the following minimum requirements:

c. ≥85µm thermoset polyester-resin powder coating on External Front Panel

d. ≥70µm thermoset polyester-resin powder coating on External Panel Base, Pillar, Compressor Cover, Fan Motor Support, Electrical Box

e. ≥1µm cellulose and polyurethane-resin coating on heat exchanger fins

f. ≥10µm polyurethane coating on printed circuit boards

g. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.

h. 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 fans shall be provided with a raised guard to prevent contact with moving parts.

4. Refrigerant and Refrigerant Piping:

a. R410A refrigerant shall be required for systems.

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 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. Future changes to indoor unit styles or sizes must be possible without resizing/replacing refrigerant piping to any other branch devices or indoor units.

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. Outdoor unit shall include Variable Evaporator Temperature or comparable method of varying system evaporator (refrigerant) temperature in order to reduce compression ratio and power consumption during light load or mild ambient temperatures. Multiple evaporator refrigerant temperature settings shall be required in order to optimize efficiency within required system-specific performance and installation constraints. System shall reduce compression ratio only when/if all indoor units are within 1.8F of setpoint; reducing compression ratio based solely on ambient temperature risks discomfort and is not allowed. Variable Evaporator Temperature or comparable method

shall incorporate override or disable capability based on external signal to allow for space humidity control or load demand.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 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 module 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 volts, 3-phase, 60 hertz or 460 volts, 3-phase, 60 hertz per equipment schedule.

b. The outdoor unit shall be controlled by integral microprocessors.

c. 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.

H. BRANCH CIRCUIT (BC) CONTROLLERS AS REQUIRED FOR SIMULTANEOUS HEAT/COOL SYSTEMS

1. General

a. BC (Branch Circuit) Controllers (or comparable branch devices) shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices which do not include controlled refrigerant subcooling risk bubbles in liquid supplied to indoor unit LEVs and are not allowed.

b. BC Controllers (or comparable branch devices) shall be equipped with a circuit board that interfaces to the controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish and be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. BC Controllers (or comparable branch devices) shall be suitable for use in plenums in accordance with UL1995 ed 4.

2. BC Unit Cabinet:

a. The casing shall be fabricated of galvanized steel.

b. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.

c. The unit shall house two tube-in-tube heat exchangers.

3. Refrigerant Piping (specifications in addition to those for outdoor unit):

a. All refrigerant pipe connections shall be brazed.

b. Future changes to indoor unit quantities or sizes served by BC Controller or comparable branch device must be possible with no piping changes except between the branch device and indoor unit(s) changing. Systems which might require future piping changes between branch device and outdoor unit—if changes to indoor unit quantities or sizes are made—are not considered equal and are not allowed.

4. Refrigerant Valves:

a. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.

5. Future Use Branch:
    a. Each VRF system shall include at least one (1) unused branch or branch device for future use. Future-use branches or branch devices shall be fully installed & wired in central location with capped service shutoff valve & service port.
6. Condensate Management:
    a. BC Controller (or comparable branch device) must have integral resin drain pan or insulate refrigeration components with removable insulation that allows easy access for future service needs. Cabinets filled with solid foam insulation do not allow for future service and are not allowed.
7. Electrical:
    a. The unit electrical power shall be 208/230 volts, 1 phase, 60 Hertz. The unit shall be capable of satisfactory operation within voltage limits of 187-228 (208V/60Hz) or 207-253 (230/60Hz).
    b. The BC Controller shall be controlled by integral microprocessors
    c. The control circuit between the indoor units and outdoor units shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

I. Y-SERIES HIGH EFFICIENCY RAPID CHANGEOVER (HEAT PUMP), AIR-COOLED OUTDOOR UNITS

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 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.
    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 64.5 dB(A) individually or 69.5 dB(A) twinned. Units shall have a sound rating no higher than 52 dB(A) individually or 54.5 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.
    d. The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.
    e. 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.
    f. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
    g. 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.

h. 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.

i. 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.

j. 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.

k. 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.

l. The outdoor unit shall be capable of operating in cooling mode down to -10□F with optional manufacturer supplied low ambient kit.

m. Low ambient kit shall be provided with predesigned control box rated for outdoor installation and capable of controlling kit operation automatically in all outdoor unit operation modes.

n. Low ambient kit shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

o. Low ambient kit shall be factory tested in low ambient temperature chamber to ensure operation. Factory performance testing data shall be available when requested.

p. 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.

q. VRF four-legged outdoor unit mounting systems shall be provided by manufacturer. Stand shall be made from 7 gauge plate steel with thermally fused polyester powder coat finish that meets ASTM D3451-06 standards. Stands shall be provided with galvanized mounting hardware and meets all ASCE 7 overturning safety requirement.

2. Unit Cabinet:

a. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

b. Outdoor unit components shall be coated with the Seacoast Protection Coating (Brine Spray – BS coating) to protect components from premature corrosion due to a seacoast environment. Coating shall be applied to components before original outdoor unit assembly to ensure manufacturer quality standards are not compromised and shall meet the following minimum requirements:

c. ≥85µm thermoset polyester-resin powder coating on External Front Panel

d. ≥70µm thermoset polyester-resin powder coating on External Panel Base, Pillar, Compressor Cover, Fan Motor Support, Electrical Box

e. ≥1µm cellulose and polyurethane-resin coating on heat exchanger fins

f. ≥10µm polyurethane coating on printed circuit boards

g. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.

h. 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 fans shall be provided with a raised guard to prevent contact with moving parts.

4. Refrigerant and Refrigerant Piping

a. R410A refrigerant shall be required for systems.

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 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.

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 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.

b. 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.

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. Outdoor unit shall include Variable Evaporator Temperature or comparable method of varying system evaporator (refrigerant) temperature in order to reduce compression ratio and power consumption during light load or mild ambient temperatures. Multiple evaporator refrigerant temperature settings shall be required in order to optimize efficiency within required system-specific performance and installation constraints. System shall reduce compression ratio only when/if all indoor units are within 1.8F of setpoint; reducing compression ratio based solely on ambient temperature risks discomfort and is not allowed. Variable Evaporator Temperature or comparable method shall incorporate override or disable capability based on external signal to allow for space humidity control or load demand.

b. 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

units over the control circuit. Required field-installed system controllers, control voltage transformers and/or signal boosters shall be provided by the manufacturer.

c. The outdoor unit shall have the capability of 4 levels of demand control for each refrigerant system based on external input.

8. Electrical:

a. The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz or 460 volts, 3-phase, 60 hertz per equipment schedule.

b. The outdoor unit shall be controlled by integral microprocessors.

c. 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. Indoor Units: WALL MOUNTED INDOOR UNIT

1. General:

a. The wall-mounted 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, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

2. Unit Cabinet:

a. All casings, regardless of model size, shall have the same white finish

b. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining are required.

c. There shall be a separate back plate which secures the unit firmly to the wall.

3. Fan:

a. The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings.

b. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).

c. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

4. Filter:

a. Return air shall be filtered by means of an easily removable, washable filter.

5. Coil:

a. Basis of design indoor units include factory-installed LEV/EEV. Alternative brands which require field-installed, accessory LEV or EEV kits are permissible only with written Engineer and Architect approval for the location of kits being submitted two weeks prior to bid date. EEV kits mounted in cavities inside fire-rated interior walls shall be mounted inside three hour fire rated enclosures with access panels supplied by the manufacturer. Enclosure type and placement require prior approval.

b. 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.

c. The coils shall be pressure tested at the factory.

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. The unit shall include an IR receiver for wireless remote control flexibility
   b. 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.
   c. 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.
   d. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
   e. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

K. 4-WAY CEILING-RECESSED CASSETTE WITH GRILLE INDOOR UNIT
1. General:
   a. The ceiling-recessed 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, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. 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 panel shall have provisions for a field installed filtered outside air intake.
   b. Branch ducting shall be allowed from cabinet.
   c. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
   d. The grille vane angles shall be individually adjustable from a wired remote controller to customize the airflow pattern for the conditioned space
3. Fan:
   a. The indoor fan shall be an assembly with a statically and dynamically balanced turbo fan direct driven by a single motor with permanently lubricated bearings.
   b. 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 (5) speed settings, Low, Mid1, Mid2, High and Auto.
   c. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.

d. The indoor unit fan logic must include multiple setting that can be changed to provide optimum airflow based on ceiling height and number of outlets used.

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. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.

g. Grille shall include a factory-installed “3D 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

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 33 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.

L. 4-WAY CEILING-RECESSED CASSETTE WITH GRILLE FOR 2X2 GRID INDOOR UNIT

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 fan shall be capable of three (3) speed settings, Low, Mid, and High.

   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 an optional “3D 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.

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.

M. MEDIUM STATIC CEILING-CONCEALED DUCTED INDOOR UNIT

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. Optional return filter box (rear or bottom placement) with high-efficiency filter as noted on equipment schedule.

5. Optional Filter Frame and Filter:

a. Filter frame shall be constructed of 20 gauge G-60 galvanized steel. Knurled thumb screws on access door allow filter replacement. Foam gasket provides air-tight connection to indoor unit and access door. Filter frame shall be configurable for rear or bottom return.

b. Filter shall be rated MERV 13 when tested in accordance with ANSI/ASHRAE 52.2

Standard Rated Class 2 under U.L. Standard 900.

6. 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.
7. 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).
8. 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. Control board shall include contacts for control of no less than two stages of external heat. The first stage of external heat may be energized when the space temperature is 2.7°F from set point for between 10-25 minutes (user adjustable). The second stage of external heat may be energized when the first stage has been active for no less than 5 minutes and the space temperature has not risen by more than 0.9°F.
   f. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
   g. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

N. CEILING-SUSPENDED INDOOR UNIT
1. General:
   a. 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, and a test run switch. The unit shall have an auto-swing function for the horizontal vane. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
2. Unit Cabinet:

a. The casing shall have a white finish.

3. Fan:
   a. The indoor unit fan shall be an assembly with two, three, or four Sirocco fan(s) 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 fan shall consist of four (4) speeds, Low, Mid1, Mid2, and High, and Auto fan function.
4. Filter:
   a. Return air shall be filtered by means of an easily removable, washable filter.
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.
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. Units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.
   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. Manufacturer to provide drain pan level sensor powered by a 20-year life lithium battery. Sensor shall require no external power for operation and shall have an audible indication of low battery condition.
   f. The 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.

O. CONTROLS

1. Overview
   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.

P. ELECTRICAL CHARACTERISTICS

1. General:

a. Controller power and communications shall be via a common non-polar communications bus and shall operate at 30VDC.

2. Wiring:

a. 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.

b. 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.

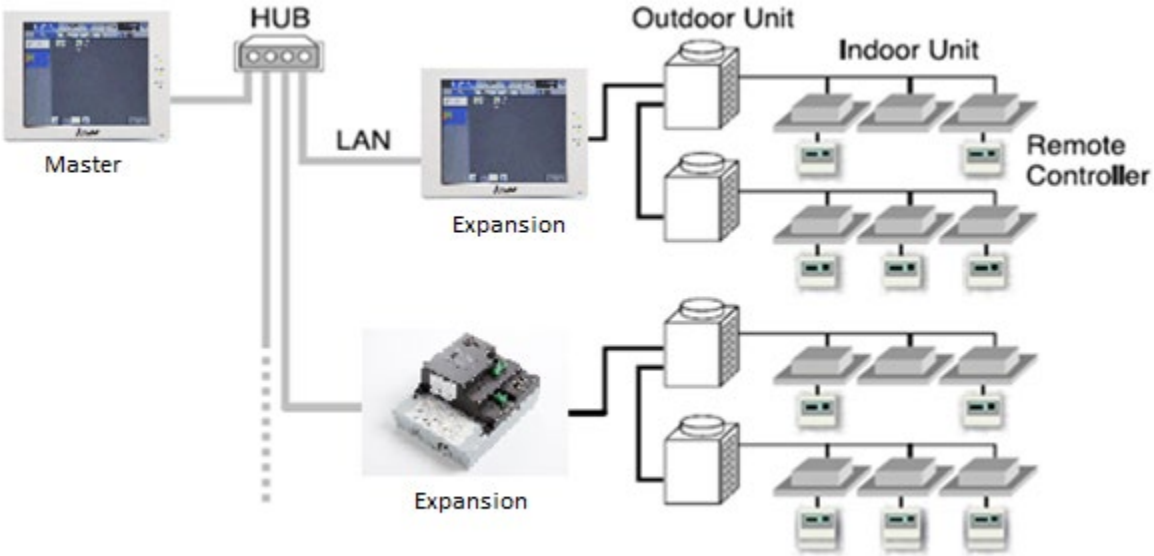
3. Wiring type:

a. Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.

b. Network wiring shall be CAT-5 with RJ-45 connection.

Q. CITY MULTI CONTROLS NETWORK

1. 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

R. REMOTE CONTROLLERS

1. Simple MA Remote Controller:

   a. The Backlit Simple MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group).

   b. 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

S. 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
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. *1. 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	Unit starts 5 - 60 minutes before the scheduled time based	Each	Each

Master Centralized Controller			
Item	**Description**	**Operation**	**Display**
Start	on the operation data history in order to reach the scheduled temperature at the scheduled time.	Block, Group or Collective	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 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, Dutch, Italian, Russian, Chinese, and Portuguese.	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 either 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	Each Block, Group or Collective	Each Group

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
	*Operation modes vary depending on the unit model connected. ** Auto mode is available for the R2/WR2-Series only.		
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 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
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	Displays the occupancy icon on the group icon in the	N/A	Each

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
Sensor	condition list page when the room is occupied (blue) or vacant (gray). *The Smart ME Remote Controller Occupancy sensor is required.		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 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
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	Operation of indoor groups, general equipment or free contact outputs based on group(s) conditions or free	Each Group,	N/A

Non Touch Screen, Networked Centralized Controller			
Item	**Description**	**Operation**	**Display**
Control	contact(s) input states.	Output or Collective	
Data Back-up (PC)	Initial setting data can be exported to a PC.	Collective	N/A

T. GRAPHICAL USER INTERFACE

The Graphical User Interface (Integrated Centralized Control Web) shall require a field supplied PC or Tablet.

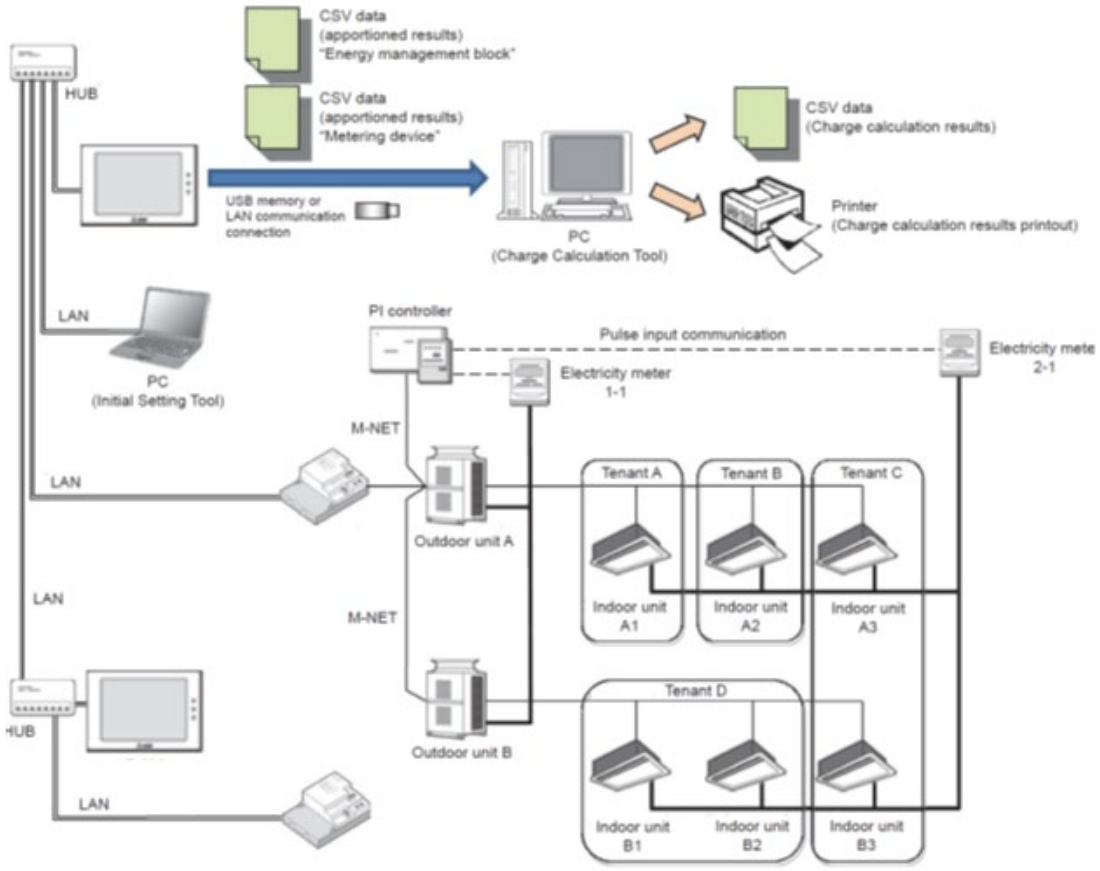
1. ICCW

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.)
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

ICCW (Integrated System Software)	
Item	**Details**
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)

U. ENERGY APPOINTMENT METHOD FOR CITY MULTI CENTRALIZED CONTROLLERS



CMCN System Configuration

1. System Overview

   a. For centralized systems serving multiple tenants for which one-to-one electricity metering is not possible, an apportioned electricity billing function that attributes just the electrical energy consumed by each individual tenant's air conditioner is required. The Energy Apportionment function takes the information on the electrical energy usage gathered

from Watt Hour Meters (WHM) connected to dedicated breaker panels serving the system's outdoor units and synthesizes it with the information on the operating status of the indoor units that is collected by the CITY MULTI centralized controller(s).

2. Watt Hour Meters
    a. Requirements:
        1) The Watt Hour Meters (WHMs) to be used to read the electrical energy consumption of the outdoor units must be capable of a pulse output, which would be configured based on the current rating of the units. The associated current transformers/ transducers (CTs) must also be sized based on the current rating of either the individual outdoor units or the dedicated air conditioning electrical panels they are to be reading. The proper quantity of meters for a particular sized system must be selected in order to ensure sufficient resolution and hysteresis in the unit pulse output of the meters so as to ascribe an acceptable level of accuracy to the apportionment of energy usage for each tenant's system. The system is designed to work with any WHM capable of a pulse output that meets ANSI C12.20 class 0.2% or 0.5% accuracy standards.
    b. Connection:
        1) The WHMs are to be physically connected to the integrated pulse input module or an external Mitsubishi Electric PI Controller if such an input is not available or if there is a wiring length limitation or installation hardship. The cable type of the interconnecting wiring shall be according to the wiring specifications of the WHM manufacturer.
3. CITY MULTI Centralized Controller Requirements
    a. Licensing:
        1) Each centralized controller to which units are assigned that require the energy apportionment function must have the "LIC-Charge" software license purchased and properly unlocked in order to enable the operating status of the indoor units to be passed to the energy apportionment tool. The procedure for licensing the centralized controllers with this function and the necessary forms can be found on Mitsubishi Electric's technical documentation repository, mylinkdrive.com. Purchase Order information for the licenses will be required at the time of submission of the licensing request forms.
    b. Dedicated master centralized controller for apportionment (no MNET connection)
        1) A dedicated master centralized controller, for which the LIC-Charge license is purchased and the energy apportionment function enabled, must be provided in order to serve as the portal for exporting metering device and energy management data to a USB drive or to a PC via LAN connection. This means that by virtue of selecting this master centralized controller to serve this function, the MNET capability of this particular centralized controller will be disabled. All indoor units must be physically wired via MNET to other expansion centralized controllers, which must be physically wired via LAN with Static IP addresses and a network hub or switch to the master apportionment controller.
4. PC for collecting charge calculation results
    a. A networked PC, which does not necessarily have to be dedicated to the task of collecting energy apportionment data, can be provided and loaded with the Charge Calculation Tool software for exporting data necessary to generate billing documentation to be performed by a third party. The system requirements of the PC are as follows:

Item	Requirements
CPU	1 GHz or better (at least 2 GHz recommended)
Memory	2GB or more
Screen Resolution	1024 x 768 or better
OS	Windows 7, Windows 8.1 (32bit/64bit)
System requirements	The system should meet the minimum requirement for Windows 7 or Windows 8.1 • Net Framework 4.5 or later
Internal LAN port or LAN card	100 BASE-TX or better
Porting device	Mouse, etc.

V. CENTRAL CONTROLLER (NON-WEB)

1. Non-Networked Touch Controller:

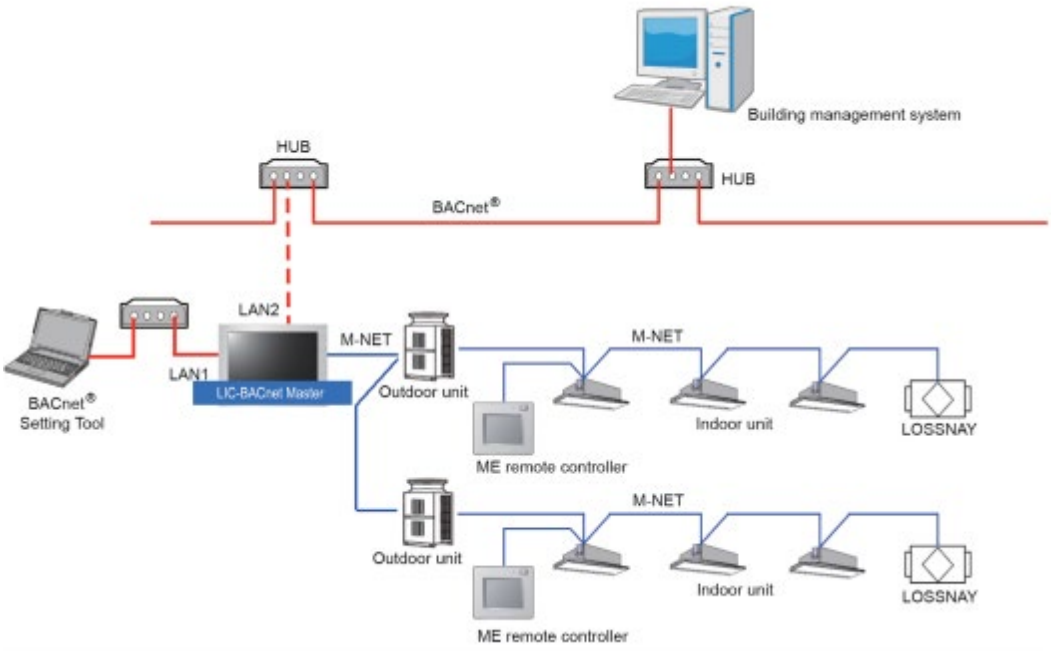
a. The Non-Networked Touch Controller features a 5 inch wide color LCD touch panel. The settings for air conditioning units can be changed by touching the corresponding icons on the display. There are 3 buttons on the panel of the controller; ON/OFF, SET BACK and HOLD enabling simple and quick batch operation. One controller can control up to 24 groups/units of air conditioners. Operation status is displayed on easy-to-read LCD. The group currently operating can be seen at a glance with the operation status display. The controller can perform functions such as ON/OFF, Operation mode changeover, temperature setting and prohibit operation by local remote controller. Up to 12 patterns of weekly schedule can be set. “ON/OFF”, “Operation mode”, “Set Temperature”, “Fan speed”, “Air flow direction” and “Permit / Prohibit local operation” can be scheduled with up to 16 settings in one pattern. Up to 5 patterns of today’s schedule can be set. Independent LOSSNAY operation is possible. Automatic ventilation, Normal ventilation and Ventilation with heat exchanger can be switched from the system controller. The controller is equipped with a system changeover function which an operation mode can be switched to an optimal mode depending on indoor temperature setting and target temperature of each group or a representative indoor unit.

Non-Networked Touch Controller:			
Item	**Description**	**Operation**	**Display**
ON/OFF	ON and OFF operation for the air conditioner units. Even when only a single indoor unit connected to the group remote controller will operate and collective ON/OFF lamp will light up.	Group or Collective	Group or Collective
Operation Mode Switching	Switches between Cool / Dry / Auto / Fan / Heat / Setback. Operation modes vary depending on the air conditioner unit. Auto mode is for CITY MULTI R2 and WR2 series only.	Group or Collective	Group or Collective
Temperature Setting	Set temperature from 57˚ F - 87˚ F depending on operation mode and indoor unit. Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.	Group or Collective	Group or Collective
Fan Speed	Available fan speed settings depending on indoor unit.	Group or	Group or

Non-Networked Touch Controller:			
Item	**Description**	**Operation**	**Display**
Setting		Collective	Collective
Air Flow Direction Setting	Air flow direction angles 4-angle or 5-angle, Swing, Auto Louver ON/OFF * Air flow direction settings vary depending on the indoor unit model.	Group or Collective	Group or Collective
Hold	Hold Prohibits the scheduled operation from being executed. a. ON/OFF timer b. Auto-OFF timer c. Weekly timer d. Automatic return to the preset temperature * While an operation is prohibited by Hold function, the operation icon lights up.	Group or Collective	Group or Collective
Permit / Prohibit	When set as the master, the ON/OFF, operation mode, setting temperature and filter sign reset operations using the local remote controllers can be prohibited. Only ON/OFF and filter reset can be prohibited for the LOSSNAY group.	Group or Collective	Group or Collective
Operation Lock	(ON/OFF, operation mode, setting temperature, fan speed, Air flow direction)	Group or Collective	Group or Collective
Room Temp Display	The room temperature can be displayed.	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. * When an error occurs, the "ON/OFF" LED flashes. The operation monitor screen show abnormal icon over the unit. 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	Each Unit, Group, or Collective
Schedule Operation	Weekly schedule setting up to 12 patterns is available. In one pattern, up to 16 setting of "ON/OFF", "Operation mode", "Set Temperature", "Fan speed", "Air flow direction" and "Permit / Prohibit local operation" can be scheduled. Today's schedule setting up to 5 pattern in available. *Time setting unit: 5 minute /unit	Each Group	Each Group
Ventilation Operation (Independent)	Group operation of only the free plan LOSSNAY is possible. The operation mode of these groups is automatic ventilation, ventilation with heat exchanger and normal ventilation.	Group or Collective	Group or Collective
Ventilation Operation (Interlocked)	The LOSSNAY will run in interlock with the operation of indoor unit. The mode cannot be changed. The LED will turn ON during operation after interlocking.	Group or Collective	Group or Collective
Set Temperature Range Limit	The range of room temperature setting can be limited by the initial setting. The lowest limit temperature can be made higher than the usual (67°F) in cool/dry mode, while the upper limit temperature lower than the usual (83°F) in heat mode.	Group or Collective	Group or 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

W. 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



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

X. Building Connect+

1. The Building Connect+ cloud based control application shall be connected to one networked centralized controller and be able to control up to 50 CITY MULTI indoor units. Additionally, the unit will include BACnet MSTP and BACnet IP control integration for up to 5 units of 3rd party equipment via installer configurable networks. Each BACnet connected device can integrate up to 10 installer selected points. The system also provides for hardwired digital I/O points including an Alarm, Status and Start/Stop for 8 additional devices such as fans or motors. A panel router is included to allow for Internet connectivity as well as 4G cellular access through the building WAN or secure VPN. The Building Connect+ cloud based user interface will be two factor authentication enabled using Google authentication. The system will provide for mobile device remote access through the cloud connection. Remote users will be able to access equipment on any and all Building Connect+ instances that are assigned to that user, regardless of geophysical location. An unlimited number of users can connect to the Building Connect+ cloud without the need for additional user licenses needed to connect remote users.
2. The platform will provide for a configuration wizard that will enable the installer to auto-discover all the connected VRF and BACnet devices. A user management function will allow the installer to set up 4 user groups consisting of Admin, Manager, Operator and user. The Admin user type will be able to configure the permissions of each user type as well as assign the equipment and points for that user type. The Admin user type will be able to add new users and manage existing users. The Admin user will configure the system access levels to be View Only, View and Control, and Hidden.
3. The CITY MULTI control points include On/off, mode, set point, air direction and fan speed. The CITY MULTI monitor only points include the full suite of available Maintenance Tool Data as well as zone temperature and error codes. User configurable functions for Alarm Management, Equipment Scheduling, Trend Building and Data management are provided with the cloud server. A Maintenance Tool data view is provided to allow the user to remotely access the data and use as a diagnostic tool in real time. Pre-programmed applications such as Auto Changeover are provided to manage automatic heat pump switching without additional equipment or programming.

Y. HVAC Equipment Alternate (General Information)

1. The alternate equipment supplier shall provide to the bidding mechanical contractor a

complete equipment data package. This package shall include, but is not limited to, equipment capacities at the design condition, power requirements, indoor units CFM/static pressures, fan curves, installation requirements, and physical dimensions. Nominal performance data is not acceptable.

2. The mechanical contractor shall request and receive the equipment data package 15 days prior to bid date and submit this package with the alternate bid.
3. The mechanical contractor shall list the equipment supplier and submit the required data package with the bid detailing a complete comparison of the proposed alternate equipment to the specified equipment and the associated cost reduction of the alternate equipment. The contractor bids an alternate manufacturer with full knowledge that that manufactures product may not be acceptable or approved.
4. The alternate equipment supplier shall furnish a complete drawing package to the mechanical contractor 15 days prior to bid day for bidding and installation. The drawing format shall be .dxf or equivalent, on 30"x42" sheets. The HVAC and electrical series design documents will be made available in electronic format for use by the equipment supplier in preparing their drawings. The alternate equipment supplier shall prepare the following drawings:
   a. XXX HVAC Floor Plan
   b. XXX HVAC Refrigerant Piping Plan
   c. XXX HVAC Refrigerant Piping/Controls Details
   d. XXX HVAC Details
   e. XXX HVAC Schedules
5. The alternate equipment supplier shall draft all piping circuits, components, overall building control schematic, detailed control wiring diagrams, system details and schedules for their system. The drawings shall convey all requirements to successfully install the alternate equipment suppliers system.
6. Provide (2) drawing package sets plotted on 20 lb. vellum. Provide (1) drawing package in electronic format (.dxf files) on CD.
7. The submitted documents shall be complete system designs and show no less information than the HVAC equipment/controls contract bid documents.
8. Provide the following scorecard(s) with the bid proposal for review by the bid selection committee for their respective system(s).

Z. R2-SERIES, HIGH EFFICIENCY, N-GENERATION

Item #	Item Description	Manufacturer Response	Response Date
1	# compressors overall # non-inverter compressors		
2	Statistical probability of warranty period compressor failure based on # compressors above and 1% warranty failure rate for each compressor for all manufacturers.		
3	# VRF systems as proposed		
4	# Branch devices included		

5	Can additional units be added or existing indoor units be replaced with units of a different size without piping changes between the branch device and outdoor unit?		
6	How is condensate formation in the branch device managed? (provide photos of branch device interior showing serviceable components)		
7	List heating/cooling performance derate factors applied to systems performance for: Ambient Temperature Indoor Temperature Piping Length & Vertical Separation Defrost		
8	Heating amount & percentage delivered during defrost		
9	Total refrigerant charge of systems provided		
10	Is commonly available polyolester (POE) used in the system?		
11	# manufacturer (or respective US division) employees based within 200 miles of job site		
12	# local distributors stocking parts within 200 mile radius		
13	# years local supplier has been selling VRF brand		

AA. Y-SERIES HIGH EFFICIENCY, N-GENERATION, RAPID CHANGEOVER

Item #	Item Description	Manufacturer Response	Response Date
1	# compressors overall # non-inverter compressors		
2	Statistical probability of warranty period compressor failure based on # compressors above and 1% warranty failure rate for each compressor for all manufacturers.		
3	Minimum compressor speed (MBH) of each system compared to the basis of design system (list each system separately)		
4	# VRF systems as proposed		
5	# Branch devices included		

6	Can additional units be added or existing indoor units be replaced with units of a different size without piping changes between the branch device and outdoor unit?		
7	How is condensate formation in the branch device managed? (provide photos of branch device interior showing serviceable components)		
8	List heating/cooling performance derate factors applied to systems performance for: Ambient Temperature Indoor Temperature Piping Length & Vertical Separation Defrost		
9	Heating amount & percentage delivered during defrost		
10	Total refrigerant charge of systems provided		
11	Is commonly available polyolester (POE) used in the system?		
12	# manufacturer (or respective US division) employees based within 200 miles of job site		
13	# local distributors stocking parts within 200 mile radius		
14	# years local supplier has been selling VRF brand		

2.7 PIPE HANGERS AND SUPPORTS

A. Provide pipe stands, supports, hangers and other supporting devices in accordance with ANSI B31.9 and MSS-69, as necessary to support work required by Contract Documents.

B. Secure vertical piping to building construction to prevent sagging or swinging.

C. Space hangers for horizontal piping as follows:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1-1/4”	3/8”	6 ft.-0”

D. Horizontal copper tubing shall have maximum hanger spacing of 5 ft. for tubing 1-1/4” diameter. Maximum spacing for PVC pipe hanger shall be 4”.

E. Reduce spacing to a maximum of 10’-0” apart, regardless of pipe size, as necessary for fittings, valves and other concentrated loads.

F. Hangers shall be as manufactured by Carpenter and Patterson, F&S or Grinnell Co. Figure numbers of Carpenter and Patterson are specified to establish standards of quality for performance and materials.

G. Hangers for horizontal lines shall be vertically adjustable to obtain pitch requirements of Piping

Paragraph.

2.8 SLEEVES AND PENETRATIONS

A. Pipe Sleeves:

1. Sleeves through floors and through exterior, structural and fire-rated construction shall be hot-dipped galvanized Schedule 40 steel pipe.

2. Sleeves through partitions and non-rated construction shall be 26-gauge galvanized steel with lock longitudinal seams, or approved plastic pipe.

3. Provide waterproofing membrane locking devices at floors. Provide 150 lb. slip-on welding flanges at exterior wall penetrations.

B. Duct Sleeves and Openings:

1. Sleeves through floors, through exterior structure, through fire-rated construction and through smoke partitions that require smoke dampers shall be Schedule 40 galvanized steel pipe for round duct and shall meet the SMACNA Fire Damper and Heat Stop Guide for rectangular ducts. Fireproof packing shall be applied to seal any openings between sleeve and wall. Materials shall maintain the fire rating of the wall, and shall be installed in accordance with the SMACNA Fire Damper and Heat Stop Guide.

2. Openings in walls, partitions and other fire-rated construction that do not require smoke dampers shall meet NFPA 90A, Section 3-3.8.

3. Materials for prepared openings in partitions shall match construction penetrated.

C. Pipe Sleeve Packing:

1. Packing between the pipe and the sleeve (or wall or slab opening) in fire-rated walls or slabs shall be a combination of fireproof insulation and fireproof caulk. The combination of materials shall have the same fire rating, in hours, as the wall or slab, as tested in accordance with the latest edition of ASTME-814 (UL 1479). The combination of materials shall be classified by UL, (fill, void or cavity materials) for the fire rating required and shall be listed as a numbered system in the UL Fire Resistance Director. Fiberglass shall not be used as the insulation material.

2. Acceptable fireproof insulation materials shall be: Kaolin (Kaowool by Babcock and Wilcox); ceramic fiber blanket (Fiberfrax by Standard Oil) or fire-rated material wool (Thermafiber by USG). Acceptable fireproof caulks shall be: Silicone (Firestop by Dow Corning, Hilti CS240); ceramic fiber (Fyreputty by Standard Oil) or intumescent synthetic elastomer (Fire Barrier Caulk by 3M, Hilti CS2420).

3. Packing for sleeves that do not require maintenance of fire rating shall be oakum, silicate foam, ceramic fiber or mineral fiber with approved sealant. Pack or foam to within 1” of both wall surfaces. Seal penetration packing with approved caulking and paintable waterproof mastic surface finish or silicone caulking.

4. All materials must be installed in accordance with manufacturer’s instructions; all gaps must be sealed. Finish caulk flush with wall or slab surface if piping runs exposed.

2.9 ESCUTCHEONS AND DUCT COLLARS

A. Provide adjustable escutcheons on exposed piping that passes through finished floors, walls and ceilings. Escutcheons shall be chromium-plated cast brass, sized to cover sleeve opening and to accommodate pipe and insulation.

B. Provide 4” wide, 20 gauge galvanized sheetmetal collars at sleeves and prepare openings, sized to cover entire duct penetration including sleeve and seal, and to accommodate duct and insulation as necessary. Edges shall have milled lips ground smooth. Paint to match finish of

duct or as directed by the Architect.

C. Provide #316 stainless steel/No. 4 finish collar for emergency generator exhaust piping which passes through exterior wall.

2.10 MOTORS, STARTERS AND WIRING

A. Provide motors and controls, and furnish starters for HVAC equipment, except units served by MCC provided under Division 26 – ELECTRICAL WORK. Provide control and other related wiring including interlocks. Power wiring (to panelboards, disconnect switches, starters and motors) will be provided under Division 26 – Electrical work. Starters that are not integral to equipment will be furnished, installed and wired under Division 26 – ELECTRICAL WORK.

B. Unless otherwise specified, motors shall be NEMA Design B, constant speed, self-ventilated squirrel cage induction. Motors shall have 1.15-service factor unless totally enclosed. Motors shall have Class B insulation.

1. Motors 1/2HP and over shall be as required in schedules.

C. All motors shall be high or premium efficiency type. They shall conform to NEMA Standard MG-1-12.53a and shall have their efficiencies determined in accordance with IEEE Standard 112 Method B. The NEMA nominal efficiency shall be listed on the motor nameplate. Minimum nominal efficiencies shall be as follows:

Size (HP)	Nominal Efficiency (Minimum)
1 – 3	84%
5 – 7-1/2	88.5%
10 – 25	90%
30 –100	93%
100+	95%

D. Starters that require interlocks or remote control shall be magnetic with “HAND-OFF-AUTOMATIC” switch on cover. Provide magnetic starters as necessary, with auxiliary contacts, buttons and switches in required configurations. Refer to paragraph AUTOMATIC TEMPERATURE CONTROLS and to Drawings for interlock requirements. Starters shall be as manufactured by one of the following manufacturers: Cutler-Hammer, Clark, Arrow Hart, or Square D.

1. Each 3-phase, 60 Hz motor shall be provided with magnetic starter with either “ON/OFF” push button or hand-off-automatic switch.
2. Other motors shall be provided with a manual starter with “ON/OFF” switch.
3. Control relay for each starter shall be for operation on 120 V, single-phase, and transformer of sufficient capacity within starter case shall be furnished for this purpose.
4. Provide inverse time limit overload and under voltage protection in each leg and with pilot lights. Provide “red” and “green” “ON/OFF” pilot lights.
5. Provide nameplates with engraved “white” lettering to designate area and equipment served.
6. Starters for refrigeration machines shall be furnished by Unit Manufacturer.
7. Provide starters for 2-speed motors with deceleration relay.
8. Furnish for all single speed motors, 25 HP and above, 95% power factor correction capacitors. Capacitors shall be in NEMA enclosure of the same rating as the motor’s starter.

2.11 FILTERS MEDIUM EFFICIENCY, THROW AWAY TYPE

A. Do not operate systems without design filters. Provide new filters before balancing. Provide

spare set of filters.

B. Provide dry type air filter gauge, with scale of 0 to 2” across filter. Gauge shall include appropriate static pressure tips, vent valves and tubing. Gauge shall be suitably marked to indicate when filter should be changed, and shall be Dwyer type or approved equal.

C. Filters shall be Farr, Cambridge or AAF, as scheduled on Drawings. Filters shall be listed by Underwriters Laboratories, Class 2.

D. Holding frames for filters shall be 16 gauge galvanized steel with polyurethane foam gaskets and fasteners. Frame shall be Farr, Type 8, or equivalent by other named manufacturers.

2.12 CABINET UNIT HEATER (ELECTRIC)

A. Furnish and install electric cabinet unit heaters as shown and scheduled on the drawings. Units shall be as manufactured by Qmark, Berko, Brasch or an approved equal. Unit heater power ratings and voltages shall match the schedules and be coordinated with the electrical plans.

B. Construction:

1. Heater assembly shall fit into a backbox and consist of all operational parts mounted to a fan panel.
2. Heating elements shall be of the non-glowing design consisting of an 80/20 nickel-chromium resistance wire enclosed in a steel sheath with copper brazed plat fins.
3. Fan shall be five-bladed aluminum.
4. Fan motor shall be totally enclosed.
5. Backbox shall be designed as a recessed rough-in type for masonry or frame installations or to be surface mounted with option frame. Box shall be 20 gauge galvanized steel and contain knockouts through which power leads are brought.
6. Front panel shall be a bar grille type constructed of 10 gauge cold-rolled steel, welded into a uniform grille and finished in a baked enamel paint.

C. Features:

1. Thermal Cutout: built into the system to shut down heater in the event of over-heating.
2. Disconnect Switch: double pole single throw type mounted on the back box for positive disconnect of unit power supply (completely concealed behind front cover).
3. Heater shall be 3-Piece Design: Backbox, heater assembly, and front panel.
4. Fan Delay Switch: shall be of bi-metallic, snap-action type and shall activate fan after heating element reaches operating temperature. Fan shall operate after thermostat is satisfied and until the heating element is cool.
5. Thermostat: Wall mounted Wifi programmable thermostat.

D. Options (provide as scheduled):

1. Disconnect Switch.
2. Manual reset thermal protection.
3. 1 inch or 2 inch deep surface mounting frames (for surface mounted heater applications).

2.13 ELECTRIC UNIT HEATERS

A. Provide electric unit heaters of horizontal discharge type, by Q Mark, Markel, Brasch or Trane, as shown on Drawings and on Schedules.

B. Casings shall be heavy gauge steel with mounting bracket.

C. Horizontal heaters shall have adjustable steel discharge louvers.

D. Electric motor shall have integral overload protection and shall be equipped with combination fan guard/motor support resiliently mounted to absorb motor vibration.

E. Fan blades shall be aluminum directly connected to fan motor and shall be dynamically balanced.

F. Fan switching shall be available to operate fan independently for summer circulation.

G. Automatic reset thermal overheat protection shall be wired for instantaneous pilot operation of built-n control contractor holding coil.

2.14 PACKAGED DOAS WITH ERV

A. FACTORY CONTROLLER: Controller shall be provided with required sensors and programming for rooftop unit. Controller shall be factory programmed, mounted and tested. Controller shall have a LCD readout for changing set points and monitoring unit operation.

B. UNIT START COMMAND (Unit will be enabled to start once a jumper is placed between R to G):

1. Factory mounted and wired outdoor air damper actuator is powered
2. Exhaust fan starts after a (adj.) delay.
3. Supply fan starts after a (adj.) delay.
4. Tempering options and energy wheel option to function as described below.

C. UNIT STOP COMMAND (OR DE-ENERGIZED):

1. Supply fan, exhaust fan, energy wheel and tempering options de-energized.
2. Outdoor air damper actuator is spring return close.

D. OCCUPIED/UNOCCUPIED MODES: Shall be based on a 7-day time clock internal to the controller. The schedule shall be set by the end user. When a user initiates an override input, the controller will switch from unoccupied to occupied mode. The controller will return to the scheduled occupied/unoccupied mode after the override time has expired. If internal time clock is disabled, a remote contact or a BMS can control the occupied/unoccupied mode.

1. Occupied Mode:
   a. Damper control per below.
   b. Energy wheel control per below.
   c. Exhaust fan ON.
   d. Supply fan ON.
   e. Heating per below.
   f. Cooling per below.
2. Unoccupied Mode (Unit Off): Unit remains off when in unoccupied mode.
   a. Supply fan OFF
   b. Exhaust fan OFF
   c. Tempering OFF
   d. Outdoor air damper closed.

E. MORNING WARMUP/COOL DOWN:

1. Prior to occupancy, the unit will run using the warmup or cool down sequence until the occupied set point is achieved. The heating or cooling mode must not be locked out and the

space temperature is below or above set point by the unoccupied hysteresis (adj.) (This Sequence must be field configured.)

F. SUPPLY BLOWER SEQUENCE:

1. The supply blower is provided with a factory mounted variable frequency drive. The supply blower speed will be controlled with the following sequence. Minimum supply fan turndown is 50% of the design maximum operation.
2. Constant Volume-Adj. Setpoint: The supply blower will operate at a constant speed set point (adj.) during operation.

G. EXHAUST BLOWER SEQUENCE:

1. The exhaust blower will operate at a constant speed set point (adj.) during operation.
2. Constant Volume-Adj. Setpoint: The exhaust blower will operate at a constant speed set point (adj.) during operation.

H. COOLING SEQUENCE:

1. The cooling is controlled to maintain the supply temperature set point. The mechanical cooling will be locked out when the outside air is < 55 F (adj.).
2. Air-Source Heat Pump: The controller will provide a modulating signal for cooling. From 0-100%, the inverter scroll will be controlled to maintain discharge temperature. The electronic expansion valve will modulate to maintain 10 F of superheat.
3. Modulating Hot Gas Reheat Sequence: During dehumidification the modulating HGRH is controlled to maintain the supply temperature set point.
4. Modulating Hot Gas Reheat: The controller will modulate the hot gas reheat reheat valve with a 0-10 V signal to maintain the supply temperature set point (adj.).

I. PRIMARY HEATING SEQUENCE:

1. The air-source heat pump is controlled to maintain the supply temperature set point. Heating will be locked out when the outside air is > 80 F (adj.). The air-source heat pump will be locked out when outside temperatures are < 0 F.
2. Air-Source Heat Pump: The controller will provide a modulating signal for heating. From 0-100%, the inverter scroll will be controlled to maintain discharge temperature. The electronic expansion valve will modulate to maintain 10 F of superheat.

J. SECONDARY HEATING SEQUENCE:

1. If the air-source heat pump cannot meet the supply temperature set point, the secondary heating source will activate and work in conjunction with the air-source heat pump.
2. Electric Heater: The controller will modulate an electric heater to maintain the supply temperature set point (adj.).

K. TEMPERATURE CONTROL SEQUENCE:

1. The unit will maintain the supply air discharge setpoint per the following. Adjustable locally or by BMS.
2. Supply Discharge Temperature Control: The supply setpoint will be a constant temperature setpoint from the controller (adj.). Adjustable locally or by BMS.

L. BUILDING FREEZE PROTECTION:

1. If the supply air temperature drops below 35 F (adj.) for 300s (adj.), the controller will de-energize the unit and activate the alarm output.

M. TEMPERATURE PROTECTION:

1. The controller will enable the supply fan to modulate down to help the unit keep up with heating demand in the event of wheel failure or the unit operating outside design conditions. (This can be enabled under the manufacturer menu in the controller)

N. UNIT LEAK DETECTION AND MITIGATION:

1. The unit will be equipped with refrigerant leak detection sensors. These sensors along with the following sequence of operation are required per UL60335-2-40.
2. Refrigerant Leak Detected In Air Tunnel: If a refrigerant leak is detected in the air tunnel, the supply fan will operate at minimum airflow requirement, outside air damper will be opened, powered exhaust fan will operate based configured sequence, energy recovery wheel will operate if commanded by normal unit sequencing, and compressors are disabled to reduce leakage rate. This operation is required in order to move stagnant refrigerant from within the unit, duct, and space ensuring proper dilution of the refrigerant. This operation is required even if the unit is called to be off. After leak detection is cleared, the unit will go back to normal operation. Exception to this operation is when the unit is receiving an active fire alarm signal at the unit controller. If unit controller is receiving a fire alarm input, the unit will not operate the leak mitigation supply fan sequence.
3. Dry alarm contacts available to allow the building (by others) to perform external mitigation actions when necessary. These by other external actions include opening of zone dampers in the ductwork, disabling duct mounted electric resistance heaters, and/or enabling additional mechanical ventilation if required per ASHRAE 15.

O. ENERGY WHEEL FROST CONTROL:

1. Frost control for the energy wheel is enabled when frost is present on the wheel; based on the outside air temperature and the pressure drop across the wheel. If the outdoor air temperature is below 5 F adj. and the differential pressure across the wheel is about 1.5", adj. frost control will enable.
2. Preheat: When frosting is occurring, the preheater is energized to defrost the wheel. Once either the pressure drop decreases below the pressure switch set point, or the outdoor air temperature increases above the temperature set point the unit will resume normal operation.

P. ECONOMIZER SEQUENCE:

1. When the application requires cooling, and the outdoor air conditions are suitable for free cooling, the controller will modulate the energy wheel speed to maintain the discharge temperature set point. If the energy wheel speed modulates to the economizer set point and the supply air temperature is not met, the controller will increase the call for cooling to meet the supply air temperature and could engage mechanical cooling.
2. Temperature: The economizer will be locked out when: the outside air temperature is outside of the set point ranges set within the controller (adj.), the unit is operating in dehumidification mode, or there is a call for heating.

Q. ALARMS INDICATION:

1. The controller will display alarms and have one digital output for remote indication of an alarm condition. Possible alarms include:
    a. Building Management System: The controller will send all alarms to the BMS.
    b. Dirty Wheel Alarm: The controller monitors pressure across the wheel and sends an alarm in the case of an increased pressure drop.
    c. Wheel Rotation Alarm: The controller monitors wheel rotation, if the wheel does not rotate for a set period of time (adj.) an alarm will generate.
    d. Supply and Exhaust Air Alarm: The controller monitors the proving switch on each blower and sends an alarm in the case of either blower proving switch not engaging.

e. Temperature Sensor Alarm: The controller sends an alarm in the case of a failed air temperature sensor.

R. ACCESSORIES:

1. The following accessories will be included with the unit to expand the functionality or usability of the controller.

a. BMS Interfacing: A BMS port or serial card is provided with the controller for field interfacing with a building management system. Each card is sent out with the default parameters, and the controls contractor must change the appropriate addresses to match the BMS settings.

b. Phase and Brownout Protection: Factory mounted and wired component which monitors the main power coming into the unit. If a phase drops out, or if the incoming voltage exceeds the acceptable range, the component will turn off the unit to help protect the electrical systems.

c. Condensate Overflow Unit Shutdown: Factory mounted condensate overflow switch wired to the unit controller. The controller monitors the condensate overflow switch. If the water level in the drain pan reaches a certain level, the unit will shutdown and send an alarm.

d. Damper End Switch: Damper end switched will be provided to ensure the supply and exhaust fans do not enable until the dampers are proven open.

2.15 AUTOMATIC TEMPERATURE CONTROLS (DIRECT DIGITAL CONTROL)

A. General:

1. Provide complete direct digital (DDC) system of automatic temperature control system as manufactured by:

a. Johnson Controls, Inc.

2. Provide the services of the control manufacturer's representative to be on site during the entire time that the startup, testing and balancing procedures, detailed in PART 3 of this Specification, takes place. The representative shall be part of manufacturer's service organization and shall be skilled in the adjustment and calibration of all control devices as well as being capable of modifying and checking system software.

3. Certify maintenance of local office within 50-mile radius of job site, staffed with factory-trained engineers capable of providing instructions to Owner's personnel and performing routing and emergency maintenance on ALL system components. Upon the Architect's request, submit a list of personnel staffing field office and their professional disciplines.

4. Provide DDC system supplier's warranty of performance of the entire system, including pneumatic components, as required by Contract Documents. Performance and component requirements are established by control sequences and diagrams on the Drawings and by this paragraph.

5. DDC systems shall perform all sequences of operation which may be listed on control Drawings or attached to this Specification. The controls supplier shall provide ALL devices necessary to completely perform sequences of operation whether such devices are explicitly shown on the Drawings specified, or not shown or specified.

B. Submittals:

1. This paragraph supplements provisions of "Submittals" paragraph of this Section 230000.

2. Materials and equipment for which Shop Drawings and Product Data submitted are required shall include, but shall not be limited to:

a. Each control system.

b. Control components including:

1) Temperature, humidity, current and static pressure sensors.

2) Direct digital field control panels.

3) Electric wiring.

c. Software.

d. Point list.

e. Detailed network diagram showing DDCFP's and communication links.

3. Submit the following for approval:

a. Control Drawings with detailed piping and wiring diagrams, including bills of materials and written description of operation for each system.

b. Panel faceplate layouts showing gauges, lights, indicators and switches with instrument ranges and nameplate inspections for local and central panels.

c. Data sheets for control system components.

d. Complete software information including names of software packages provided, control sequences performed including flow chart logic diagrams, complete information on user programmability (commands, language details, programming sequences, etc.) and complete description of operating system.

4. Provide initial design and as-built construction Drawings to Owner's operating personnel.

5. Provide narrative descriptions of sequences of operations, including input and output air pressure for each pneumatic components. Descriptions shall not merely duplicate specified sequences of operations.

C. Guarantee control system free from defects in material and workmanship and guarantee performance of systems as required by Contract Documents for one (1) year of normal use and service beginning on date Owner begins to receive beneficial use of system.

D. Programmed Maintenance, Startup and Software Updates:

1. Submit manufacturer's agreement to provide necessary programmed maintenance and to maintain systems for one (1) year from date of Final Acceptance within Contract sum.

2. Programmed maintenance agreement shall identify maintenance work to be performed and shall quote cost of work for two (2) years subsequent to guarantee period.

3. Start system and perform necessary testing and debugging. Perform acceptance test in presence of Owner's Representative and Engineer. Provide 15 days' notice before acceptance test. Notice shall certify that the system is complete and operates as required by the Contract Documents. When the system performance is deemed satisfactory, system parts will be accepted for beneficial use and warranty shall begin. Note additional requirements in PART 3 of this Specification.

4. Update software free of charge during warranty as manufacturer's software is improved.

5. Provide 40 hours of on-site instruction in operating the DDC system. Furnish three (3) copies of operating manuals for the complete system.

6. Computer to support color graphics software package shall have the following requirements:

a. Server Hardware Requirements: The server hardware platform shall have the following requirements:

1) The computer shall be a current version of Dell Precision mobile 17” workstation with docking station or equivalent. Docking station shall be capable of connecting external monitors and wired LAN connections.

2) Connection to the BAS network shall be via an Ethernet network interface card, 100 Mbps.

E. Operator Interface:

1. Basic Interface Description:

a. Command Entry/Menu Selection Process: Operator workstation interface software shall minimize operator training through the use of English language prompting, English language point identification and industry standard PC application software.

1) The operator interface shall minimize the use of a typewriter style keyboard through the use of a mouse or similar pointing device, and “point and click” approach to menu selection. For example, users shall be able to start and stop equipment or change setpoints from graphical displays through the use of a mouse or similar pointing device.

b. Graphical and Text-Based Displays: At the option of the user, operator workstations shall provide consistent graphical or text-based displays of all system point and application data described in this Specification. Point identification, engineering units, status indication and application naming conventions shall be the same at all operator devices.

c. Multiple, Concurrent Displays: The operator interface shall provide the ability to simultaneously view several different types of system displays in a windowing environment to speed facility operation and analysis. For example, the interface shall provide the ability to simultaneously display a graphic depicting an air handling unit, while displaying the trend graph of several associated space temperatures to allow the user to analyze system performance. If the interface is unable to display several different types of displays at the same time, the FMS Contractor shall provide at least two (2) operator stations.

d. Password Protection: Multiple-level password access protection shall be provided to allow the user/manager to limit workstation control, display and data base manipulation capabilities as he deems appropriate for each user, based upon an assigned password.

1) Passwords shall be exactly the same for all operator devices, including DDC panel portable or panel-mounted network terminals. Any additions or changes made to password definition shall automatically cause passwords at all DDC panels on a network to be updated and downloaded to minimize the task of maintaining system security. Users shall not be required to update passwords for DDC panels individually.

2) A minimum of five (5) levels of access shall be supported.

3) A minimum of 50 passwords shall be supported at each DDC panel.

4) Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed at operator device, including portable or panel-mounted devices, shall be limited to only those defined for the access level of the password used to log-on.

5) User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving devices on-line.

e. Operator Commands: The operator interface shall allow the operator to perform commands including, but not limited to the following:

1) Startup or shutdown selected equipment.

2) Adjust setpoints.
3) Add/Modify/Delete time programming.
4) Enable/Disable process execution.
5) Lock/Unlock alarm reporting for each point.
6) Enable/Disable totalization for each point.
7) Enable/Disable trending for each point.
8) Override PID loop setpoints.
9) Enter temporary override schedules.
10) Define Holiday schedules.
11) Change time/date.
12) Enter/Modify analog alarm limits.
13) Enter/Modify analog warning limits.
14) View limits.
15) Enable/Disable demand limiting for each meter.
16) Enable/Disable duty cycle for each load.

f. Logs and Summaries: Reports shall be generated automatically or manually, and directed to the computer station. As a minimum, the system shall allow the user to easily obtain the following types of reports.
1) A general listing of all points in the network.
2) List of all points currently in alarm.
3) List of all off-line points.
4) List all points currently in override status.
5) List of all disabled points.
6) List all points currently locked out.
7) List of all items defined in a “Follow-up” file.
8) List all weekly schedules.
9) List all Holiday programming.
10) List of limits and dead-bands.
a) Summaries shall be provided for specific points, for a logical point group, for a user-selected group or groups, or for the entire facility without restriction due to the hardware configuration of the Facility Management System. Under no conditions shall the operator need to specify the address of hardware controller to obtain system information.

g. Paging Interface Software: The operator workstation shall be capable of transmitting alarms to both numeric and alphanumeric paper messages. The message sent to an alphanumeric pager can include the critical alarm text and optionally a description of what action to take. The scheduling feature shall allow time of day pagers are enabled, up to four (4) enable/disable periods a day for each pager. The application shall be password protected and capable of supporting 1,500 pagers.

2. Third Party Software Interaction:

a. Third party interface system data, including transactions, alarms, totalization files, etc., shall be stored on the workstation disk drive in an industry standard database format (e.g., dbase IV) such that it is compatible with off-the-shelf third party database and spreadsheet programs.

b. Live FMS Data Exchange: The Facility Management System shall interface to off-the-shelf personal computer software programs (e.g., Microsoft Word for Windows, Microsoft Excel, Lotus, etc.). This interface shall conform to Microsoft Corporation's Dynamic Data Exchange (DDE) protocols and standards. The user shall have the ability to "link" the computer programs directly to line, real-time Facility Management System data values. Systems that offer data exchange using only historical, disk resident information will not be acceptable. FMS data value "read" and "writes" shall both be permissible.

3. Dynamic Color Graphic Displays: 1. Color graphic floor plan displays, and 2. System schematic (for each piece of mechanical equipment; including air handling units, chilled water systems and hot water boiler systems), shall be provided as part of this contract. The total quantity shall be a minimum of two (2).

   a. System Selection/Penetration: The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands.

   b. Dynamic Data Displays: Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention.

   c. Windowing: The windowing environment of the PC operator workstation shall allow the user to simultaneously view several graphics at the same time, to analyze total building operation, or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

   d. Graphics Definition Package: Graphic generation software shall be provided to allow the user to add, modify or delete system graphic displays

      1) The FMS Contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers, etc.), complete mechanical systems (e.g. constant volume-terminal reheat, VAV, etc.) and electrical symbols.

         a) Define symbols:

            (1) Position and size symbols.

            (2) Define background screens.

            (3) Define connecting lines and curves.

         b) Locate, orient and size descriptive text.

         c) Define and display colors for all elements.

         d) Establish correlation between symbols or text and associated system points or other displays.

4. System Configuration and Definition: All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.

   a. The system shall be provided compete with all equipment and documentation necessary to allow an operator to independently perform the following functions:

      1) Add/Delete/Modify standalone DDC panels.

      2) Add/Delete/Modify operator workstations.

3) Add/Delete/Modify application specific controllers.

4) Add/Delete/Modify points of any type, and all associated point parameters and tuning constants.

5) Add/Delete/Modify alarm reporting definition for each point.

6) Add/Delete/Modify control loops.

7) Add/Delete/Modify energy management applications.

8) Add/Delete/Modify time (and calendar) based programming.

9) Add/Delete/Modify totalization for every point.

10) Add/Delete/Modify historical data trending for every point.

11) Add/Delete/Modify custom control processors.

12) Add/Delete/Modify any and all graphic displays, symbols and cross-references to point data.

13) Add/Delete/Modify dial-up telecommunication definition.

14) Add/Delete/Modify all operator passwords.

15) Add/Delete/Modify alarm messages.

b. Programming Description: Definition of operator device characteristics, DDC panels, individual points, applications and control sequences shall be performed through fill-in-the-blank templates and graphical programming approach.

1) Graphical programming shall allow the user to define the software configuration of DDC control logic for HVAC system control sequences, fan interlocks and other control relationships through the creation of graphical logic flow diagrams.

2) Graphical Programming: Control sequences are created by using a mouse input device to draw interconnecting lines between symbols depicting inputs, operators (comparisons and mathematical calculations), and outputs of a control sequence. As a minimum, graphic symbols shall be used to represent:

a) Process inputs, such as temperature, humidity or pressure values, status, time, date, or any other measured or calculated system data.

b) Mathematic process operators, such as addition, subtraction, multiplication, greater than, equal to, or less than, etc.

c) Logical process operators such as AND, OR; exclusive OR, NOT, etc.

3) Time Delays:

a) Process control outputs such as start/stop control points, analog adjust points, etc.

b) Process calculation outputs.

c) Text-file outputs and advisories.

(1) Network-Wide Strategy Development: Inputs and outputs for any process shall not be restricted to DDC panel, but shall be able to include data from any and all other DDC panels to allow the development of network-wide control strategies. Processes shall also allow the operator to use the results of one process as the input to any number of other processes (cascading).

(2) Sequence Testing and Simulation: A software tool shall be provided, which allows a user to simulate control sequence execution and test strategies

before they are actually applied to mechanical systems. Users shall be able to enter hypothetical input data, and verify desired control responses and calculation results via graphical displays and hardcopy printouts.

c. System Definition/Control Sequence Documentation: All portions of system definition shall be self-documenting to provide hardcopy printouts of all configuration and application data. Control process and DDC control loop documentation shall be provided in logical, graphical flow diagram format to allow control sequences to be easily interpreted and modified at any time in the future.

d. Database Save/Restore/Backup: Backup copies of all standalone DDC panel databases shall be stored in at least one (1) operator workstation.

1) Continuous supervision of the integrity of all DDC panel databases shall be provided. In the event that any DDC panel on the network experiences a loss of its data base for any reason, the system shall automatically download a new copy of the respective database to restore proper operation. Database backup/download shall occur over the local area network without operator intervention. Users shall also have the ability to manually execute downloads of any or all portions of a DDC panels database.

e. Air Handlers:

1) Supply fan status/selection.

2) Return fan status.

3) Discharge air setpoint/selection.

4) Mixed air temperature.

5) Outdoor air temperature.

6) Smoke detector – normal/alarm.

7) Freezestat – normal/alarm.

8) Static pressure high limit – normal/alarm.

9) Static pressure low limit – normal/alarm.

10) Filter differential pressure – normal/alarm.

11) Supply cfm.

12) Return cfm.

13) Space temperature sensor setpoint/selection.

14) Warm up sensor setpoint/selection.

15) Space relative humidity sensor setpoint/selection.

16) Return air relative humidity sensor setpoint/selection.

17) High limit humidistat – normal/alarm.

18) Time based schedule start/stop time selection.

F. Integration with Third-Party Manufacturer's Equipment:

1. General: The Facility Management System (FMS) shall be capable of inter-operating with multiple building systems supplied by different manufacturers. The FMS shall be able to receive, react to and in some cases, return information from multiple building systems.

a. Point inputs and outputs from the third-party controllers shall have real-time inter-operability with FMS software features such as: Control Software, Energy Management, Custom Process Programming, Alarm Management, Historical Data and Trend Analysis,

Totalization and Dial-up and Local Area Network Communications, as mentioned earlier in this Specification.

2. Networking/Communications:
   a. The FMS shall support any combination of third-party controllers (if more than one (1) third-party manufacturer is being integrated) on a single network.
   b. A minimum of 100 third-party controllers shall be supported on a single network.
   c. Integration shall be by RS-232 or RS-485 technologies.
3. Diagnostic/Verification: The installer/operator shall have the ability to verify and diagnose communication messages and point information between third-party controllers and the Facility Management System.
4. Point Inputs and Outputs: The FMS shall be able to monitor and control the following third-party controller point inputs and outputs.

G. DDC System Architecture:

1. The specified DDC system shall consist of an information sharing network of stand-alone direct digital control panels to monitor and control the specified mechanical equipment per the control sequence and input/output summary. Information sharing network shall be defined as the ability of each Direct Digital Control Field Panel (DDCFP) to exchange information on the network with other DDCFP without the need of front end devices such as a central computer, gateways or any other network managing device. The stand-alone capability shall be defined as the ability of each DDC panel to independently monitor and control connected mechanical equipment through its own internal microprocessor.
2. The DDCFP network shall operate on a true token pass, peer to peer communication basis. The internal microprocessor which resides within each DDCFP shall provide for full exchange of system information between each DDCFP on the network communication trunk. Systems which rely on a central processor, or similar device, to exchange system information shall not be acceptable. Failure of any one of the network DDCFP panels shall not affect the operation of other DDC panels residing on the same network. All DDC panel/point failures shall be annunciated at specified printers or terminals.
3. It is recognized that some systems may use stand-alone terminal unit controllers on the network, between the DDCFP and the equipment to be controlled. Such controllers may control an individual VAV box, heat pump or fan coil. It is not the intent of this Specification that terminal unit controllers communicate directly with each other without going through the DDCFP.
4. Network transmission shall occur at minimum rate of 9600 band. This includes transmission on data bus from DDCFP to DDCFP and from DDCRP to host computer. Full communications shall be sustained as long as there are at least two operational DDCFP's on any segment of the bus. All transmissions shall incorporate data integrity and validity check routings by virtue of either Manchester encoding, double transmission or parity bit techniques. The DDC system shall clearly state the DDC submittal that data integrity and validity routines are incorporated in the system and the technique used and incorporated.

H. Direct Digital Control Field Panels (DDCFP):

1. General: Standalone DDC panels shall be microprocessor based, multi-tasking, multi-user, real-time digital control processors. Each standalone DDC panel shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output modules. A sufficient number of controllers shall be supplied to fully meet the requirements of this Specification and the attached point list.
2. Memory: Each DDC panel shall have sufficient memory (minimum 4 megabytes) to support its own operating system and databases including:

a. Control processes.
b. Energy management applications.
c. Alarm management.
d. Historical/Trend data for all points.
e. Maintenance support applications.
f. Custom processes.
g. Operator I/O.
h. Dial-up communications.
i. Manual override monitoring.

3. Point Types: Each DDC panel shall support the following types of point inputs and outputs:
   a. Digital inputs for status/alarm contacts.
   b. Digital outputs for on/off equipment control.
   c. Analog inputs for temperature, pressure, humidity, flow and position measurements.
   d. Analog outputs for valve and damper position control and capacity control of primary equipment.
   e. Pulse inputs for pulsed contact monitoring.
4. Expandability: The system shall be modular in nature, and shall permit easy expansion through the addition of software applications, workstation hardware, field controllers, sensors and actuators.
5. Serial Communication Ports: Standalone DDC panels shall provide at least two (2) RS-232C serial data communication ports for simultaneous operation of multiple operator I/O devices such as industry standard printer, laptop workstations, PC workstations and panel-mounted or portable DDC panel operator's terminals. Standalone DDC panels shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers or network terminals.
6. Hardware Override Switches: As indicated in the point schedule, the operator shall have the ability to manually override automatic or centrally executed commands at the DDC panel via local, point discrete, onboard hand/off/auto operator override switches for binary control points and gradual switches for analog control type points. These override switches shall be operable whether the panel is powered or not.
7. Hardware Override Monitoring: DDC panels shall monitor the status or position of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited. DDC panels shall also collect override activity information for daily and monthly reports.
8. Local Status Indicator Lamps: The DDC panel shall provide local status indication for each binary input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.
9. Integrated On-Line Diagnostics: Each DDC panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of subsidiary equipment. The DDC panel shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each DDC panel, and shall not require the connection of an operator I/O device.
10. Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE

Standard 587-1980.

11. Powerfail Restart: In the event of the loss of normal power, there shall be an orderly shutdown of all standalone DDC panels to prevent the loss of database or operating system software. Non-Volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the real time clock and all volatile memory for a minimum of 72 hours.
    a. Upon restoration of normal power, the DDC panel shall automatically resume full operation without manual intervention.
    b. Should DDC panel memory be lost for any reason, the panel will automatically receive a download via the local area network, phone lines or connected computer. In addition, the user shall have the capability of reloading the DDC panel via the local area network, via the local RS-232C port, or via telephone line dial-in.

I. System Software Features:
    1. General:
        a. All necessary software to form a complete operating system as described in this Specification shall be provided.
        b. The software programs specified in this Section shall be provided as an integral part of the DDC panel and shall not be dependent upon any higher level computer for execution.
    2. Control Software Description:
        a. Pre-Tested Control Algorithms: The DDC panels shall have the ability to perform the following pre-tested control algorithms:
            1) Two position control.
            2) Proportional control.
            3) Proportional plus integral control.
            4) Proportional, integral plus derivative control.
            5) Automatic control loop tuning.
        b. Equipment Cycling Protection: Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
        c. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during startup period by automatically introducing time delays between successive start commands to heavy electrical loads.
        d. Powerfail Motor Restart: Upon the resumption of normal power, the DDC panel shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling and turn equipment on or off as necessary to resume normal operation.
    3. Energy Management Applications:
        a. DDC panels shall have the ability to perform any or all of the following energy management routines:
            1) Time of day scheduling.
            2) Calendar based scheduling.
            3) Holiday scheduling.
            4) Temporary schedule overrides.
            5) Optimal start.

6) Optimal stop.

7) Night setback control.

8) Enthalpy switch over (economizer).

9) Peak demand limiting.

10) Temperature compensated load rolling.

11) Fan speed/CFM control.

12) Heating/cooling interlock.

b. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow operator customization. Programs shall be applied to building equipment as described in the “Execution” portion of this Specification.

4. Custom Process Programming Capability: DDC panels shall be able to execute custom, job-specific processes defined by the operator, to automatically perform calculations and special control routines.

a. Process Inputs and Variables: It shall be possible to use any of the following in a custom process:

1) Any system-measured point data or status.

2) Any calculated data.

3) Any results from other processes.

4) User-defined constants.

5) Arithmetic functions (square roots, exponential, etc.).

6) Boolean logic operators (and, or exclusive or, etc.).

7) On-delay/Off-delay/One-shot timers.

b. Process Triggers: Custom processes may be triggered based on any combination of the following:

1) Time interval.

2) Time of day.

3) Date.

4) Other processes.

5) Time programming.

6) Events (e.g., point alarms).

c. Dynamic Data Access: A single process shall be able to incorporate measured or calculated data from any and all other DDC panels on the local area network.

1) In addition, a single process shall be able to issue commands to points in any and all other DDC panels on the local area network.

d. Advisory/Message Generation: Processes shall be able to generate operator messages and advisories to operate I/O devices. A process shall be able to directly send a message to specified device, buffer the information in a follow-up file or cause the execution of a dial-up connection to a remote device such as a printer.

e. Custom Process Documentation: The custom control programming feature shall be self-documenting. All interrelationships defined by this feature shall be documented via graphical flowcharts and English language descriptions.

5. Alarm Management: Alarm management shall be provided to monitor, buffer and direct alarm reports to operator devices and memory files. Each DDC panel shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the DDC panel's ability to report alarms be affected by either operator activity at a PC workstation or local I/O device, or communications with other panels on the network.
    a. Point Change Report Description: All alarm or point change reports shall include the point's English language description and the time and date of occurrence.
    b. Prioritization: The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three (3) priority levels shall be provided. Each DDC panel shall automatically inhibit the reporting of selected alarms during system shutdown and startup. Users shall have the ability to manually inhibit alarm reporting for each point.
        1) The user shall also be able to define under which conditions point changes need to be acknowledged by an operator, and/or sent to follow-up files for retrieval and analysis at a later date.
    c. Report Routing: Alarm reports, messages and files will be directed to a user-defined list of operator devices for archiving alarm information. Alarms shall also be automatically directed to a default device in the event a primary device is found to be off-line.
    d. Alarm Messages: In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 65-character alarm message to more fully describe the alarm condition or direct operator response.
    e. Auto-Dial Alarm Management: In dial-up applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by time-stamping and saving reports until an operator scheduled time, a manual request or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.
    f. Transaction Logging: Operator commands and system events shall be automatically logged to disk in Personal Computer Industry Standard Database Format. Operator commands initiated from direct connected workstations, dial-up workstations and local DDC panel network terminal devices shall all be logged to this transaction file. This data shall be available at the Operator workstation. A utility shall be provided to allow the user to search the transaction file using standard database query techniques, including searching by dates, operator name, data point name, etc. In addition, this transaction file shall be accessible with standard third-party database and spreadsheet packages.
6. Historical Data and Trend Analysis: A variety of historical data collection utilities shall be provided to automatically sample, store and display system data in all of the following ways:
    a. Continuous Point Histories: Standalone DDC panels shall store point history files for all analog and binary inputs and outputs.
        1) The point history routine shall continuously and automatically sample the value of all analog inputs at half hour intervals. Samples for all points shall be stored for the past 24 hours to allow the user to immediately analyze equipment performance and all problem-related events for the past day. Point history files for binary input or output points and analog output points shall include a continuous record of the last ten (10) status changes or commands for each point.
    b. Control Loop Performance Trends: Standalone DDC panels shall also provide high resolution sampling capability in one-second increments for verification of control loop performance.
    c. Extended Sample Period Trends: Measured and calculated analog and binary data shall

also be assignable to user-definable trends for the purpose of collecting operator-specified performance data over extended periods of time. Sample intervals of 1 minute to 2 hours shall be provided. Each standalone DDC panel shall have a dedicated buffer for trend data and shall be capable of storing a minimum of 5000 data samples.

d. Data Storage and Archiving: Trend data shall be stored at the Standalone DDC panels and uploaded to hard disk storage when archival is desired. Uploads shall occur based upon either user-defined interval, manual command or when the trend buffers become full. All trend data shall be available in disk file format compatible with third-party personal computer applications.

7. Runtime Totalization: Standalone DDC panels shall automatically accumulate and store runtime hours for binary input and output points as specified in the "EXECUTION" portion of this Specification.

   a. The totalization routine shall have a sampling resolution of one minute or less.

   b. The user shall have the ability to de-frame a warning limit for runtime totalization. Unique, user-specified messages shall be generated when the limit is reached.

8. Analog/Pulse Totalization: Standalone DDC panels shall automatically sample, calculate and store consumption totals on a daily, weekly or monthly basis for user-selected analog and binary pulse input-type points.

   a. Totalization shall provide calculation and storage of accumulations of up to 99,999.9 units (e.g. KWH, gallons, KBTU, tons, etc.).

   b. The totalization routine shall have a sampling resolution of one minute or less.

   c. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

9. Event Totalization: Standalone DDC panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis.

   a. The event totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.

   b. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

10. Locate DDCFPs, slave panels (if provided), relay panels, pneumatic central panels and other temperature control system enclosures in the following areas only:

    a. Furnish and install a Hays compatible 38900 baud auto answer modem onto the network. Having dialed into the network through the modem, an operator shall have full access, providing they have a proper password, to the entire network of DDCFPs as if physically connected to the actual network. In no way shall it be necessary for the operator to have access to each individual DDCFP for information about the entire facility.

J. Portable Operator's Terminals: Each DDC panel shall be capable of supporting an operator's terminal for local command entry, instantaneous and historical data display, and program additions and modifications. Provide two (2) portable operator's terminals.

1. There shall be a provision for both, permanently mounting the standalone DDC panel operator terminal, or using it as a portable hand-held unit.

2. The DDC panel operator terminal shall simultaneously display a minimum of 6 points with full English identification, to allow an operator to view single screen dynamic displays depicting entire mechanical systems.

3. The operator functions provided by the DDC panel operator terminal shall include, but not be

limited to, the following:

a. Start and stop points.

b. Modify setpoints.

c. Modify PID loop setpoints.

d. Override PID control.

e. Change time/date.

f. Add/Modify Start/Stop weekly scheduling.

g. Add/Modify setpoint weekly scheduling.

h. Enter temporary override schedules.

i. Define Holiday schedules.

j. View analog limits.

k. Enter/Modify analog warning limits.

l. Enter/Modify analog alarm limits.

m. Enter/Modify analog differentials.

n. View point history files.

4. The DDC panel operator terminal shall provide access to all rear or calculated points in the controller to which it is connected or any other controller in the network. This capacity shall not be restricted to a set of predefined “global points”, but shall provide totally open exchange of data between the operator terminal and any DDC panel in the network.

5. Operator access at all DDC Operator Terminals shall be identical to each other, as well as identical to the PC or Laptop Operator Workstations. Any password changes shall automatically be downloaded to all DDC controllers on the network.

6. The DDC panel operator terminal shall provide English language prompting to eliminate the need for the user to remember command formats or point names. Prompting shall be provided consistent with a user’s password clearance and the types of points being displayed, to eliminate the possibility of operator error.

7. A multi-function touchpad shall be provided for point and command selection, as well as parameter entry. To minimize the possibility of operator error, the DDC panel operator terminal shall change and limit touchpad functions based upon an operator’s password clearance, the function being performed and types of points being displayed. Screen displays shall clearly indicate only valid touchpad functions.

8. Context-Sensitive Help: On-line, interactive user’s “Help” manuals and tutorials shall be provided. Based upon operator request, the “help” function shall provide general system operating instructions and specific descriptions of commands available in the currently displayed menus.

9. Identification for all real or calculated points shall be consistent for all network devices. The same English language names used at PC workstations shall be used to access points at the DDC panel operator’s terminal to eliminate cross-reference or lookup tables.

10. In addition to instantaneous summaries, the DDC panel operator’s terminal shall allow a user to view a point history file for system points. Point history files shall provide a record of value of analog points over the last 24 hours, at 30 minute intervals or a record of the last ten (10) status changes for binary type points.

K. DDC Terminal Box Controllers: The ATC Contractor shall provide microprocessor based terminal

unit controllers for variable air volume terminal boxes. ATC Contractor shall have responsibility for the provision of damper actuator, microprocessor based controller, control transformer, velocity pressure transducer, room sensors and all control wiring.

1. The ATC shall have responsibility for startup, checkout, calibration and replacement of all control system components. ATC shall have responsibility of mounting control components whether components are mounted in the field or at the box manufacturer's plant.
2. The ATC shall determine compatibility of pressure sensor output provided with terminal box with transducer and control software and provide appropriate and compatible components.
3. Terminal unit control system shall perform sequences of control as described on the Drawings. In general, the controller shall provide for cooling, warm-up, night heating, tenant override. See sequences for specific requirements.
4. Provide one (1) portable operator's terminal for balancers use during balancing with unit being provided to Owner when balancing is done. Operator's terminal shall permit readout of system variable, override control and adjustment of control parameters. Operator's terminals shall be hand-held, complete with keyboard and plug directly into wall-mounted sensors for power and data.
5. The Controls Contractor shall ensure that the control transformer which he provides is compatible with the electrical power feed to each terminal box, provided under Division 26 – ELECTRICAL, and with the requirements of the fan and electric coil provided with terminal fan box (or provided under the work of the Mechanical section if a duct-mounted coil).

L. DDC Terminal Box Monitoring and Control Functions: From a portable operators terminal, it shall be possible to provide the following control and monitoring functions for each DDC terminal box:

1. Indicate system status (heating, cooling, out of control range).
2. Display, set and manually override minimum and maximum air duct flow in cfm. Display actual cfm.
3. Display space temperature.
4. Display, set and manually override space temperature setpoint and dead-band.
5. Set and change heating/cooling dead-band.
6. Display damper and valve position in percent open notation.
7. Command damper and valve position in percent open notation.
8. Select application mode.
9. Assign terminal control unit address.
10. Display and manually override reheat.
11. Set and change control loop gains.
12. Change unoccupied/occupied mode.

M. DDC Sensors and Point Hardware:

1. General: When providing instruments with 4-20 mA transmitters and conversation to voltage is required at DDCFP, Controls Contractor shall provide 250 ohm, 1% precision resistor.
2. Alarms:
   a. Alarm contacts shall be wired normally closed (NC). When in alarm condition or if wire to contact is open (wire cut), DDCFP shall sense condition and generate alarm.
   b. Common alarms shall be wired relay coils in parallel with common alarm pilot light or to alarm terminals on manufacturer's control panel. Contractors shall input to DDCFP. Line

printer shall indicate normal or alarm.

3. DDC Sensors and Point Hardware:
   a. Temperature Sensors: Temperature sensors shall conform to the following minimum standards. Additional Specifications are given for specific applications below:
      1) Sensors shall be accurate to + 0.25° F over minimum operating ranges.
      2) Sensor, associated circuitry and readout shall have minimum resolution of 0.25° F.
      3) Sensors shall withstand ambient temperatures of -30° F to 240° F, but performance requirements must be met only for ranges selected.
   b. Provide thermistor (1,000 ohms or greater) or resistance temperature detector (RTD) sensors, for the following applications and minimum operating ranges.
      1) Wall-Mount Space Sensor - 40° F to 100° F.
      2) Duct-Mount Sensor - 20° F to 120° F.
   c. Provide thermistor (1,000 ohms or greater) or resistance temperature detector (RTD) sensors, for outside air temperature measurement. Sensor shall be mounted in 24-hour shaded location, in proximity to a light colored wall, in an aspirated enclosure insulated with foam from thermal transfer with adjacent structure. Sensors shall operate within the following minimum range: 20° F to 120° F.
   d. Provide averaging resistance temperature detector (RTD) sensor only, for mixed air measurement. Sensor shall provide a minimum duct coverage 1 foot per 2 feet of duct. Sensor shall not come in direct contact with water or steam coils. The sensor shall operate within the following range: 30° F to 120° F.
   e. Provide wall-mount sensor for range specified above. When sensors are mounted in private office spaces they shall have a local setpoint adjustment. The setpoint range can be limited from DDCFP or front-end computer. All other sensors shall have blank faceplates. Sensors shall have features as listed.
4. Humidity Sensors and Transmitters: Humidity accuracy shall be +5% at full scale. Sensors shall contain integral single point calibration potentiometer.
   a. Sensors shall be mounted so field calibration may be done without disrupting sensor operation. For duct-mounted transmitters, coordinate access panel for field calibration/verification with sheetmetal.
   b. Sensors shall be Vaisala, General Eastern, or Staefa.
   c. Sensors shall be manufactured by Vaisala.
5. Pressure Sensors and Transmitters: All pressure instruments shall conform to the following minimum standards. Additional Specifications are given for specific applications below:
   a. Sensors shall be accurate to +1.0% of full scale (RSS method) and temperature effect shall contribute error less than +0.04% over the full scale of measurement.
   b. Sensors shall withstand up to 150% of rated pressure, but performance requirements must be met only for ranges specified.
   c. Sensor shall have separate zero and span adjustments for future field calibration. Adjustments shall be non-interactive. Sensors shall be manufactured and calibrated through system acceptance by Setra of Modus.
   d. Provide sensors of the specific type for the following applications and operating ranges.

System pressure	Gap pressure	125% system

Duct static	Differential	0-5” WC
System differ. supply/return diffuser	Differential	125% max. rated pump head
Filter	Differential	0-2” WC

N. DDC Software:

1. Provide software required for efficient system operation as required by Contract Documents. Software shall be modular in design for flexibility in expansion and revision.
2. Software shall comprise computer-vendor supplied and supported, real-time disk operating system. Real-time operating system executive shall control timing and sequencing of programs. Submit copies of software on disk to Owner and maintain backup copy.

O. Smoke Detection and Dampers in Air Handling Units:

1. Install duct smoke detectors furnished under Division 16 where shown on Drawings. Wire to fan shutdown. Wiring to fire alarm system shall be part of work of Division 16.
    a. Provide normally open smoke dampers in return and supply air ducts to close automatically upon fan shutdown due to fire or smoke detection or upon manual shutdown.
2. Smoke dampers shall be controlled so that fans shall not start until dampers are open and fans shall stop before smoke dampers are fully closed. End switches, damper switches and other components required shall be by temperature control manufacturer.

P. Low Temperature Thermostat: Provide low temperature thermostats as shown on Drawings. Thermostat shall register alarm condition and shut down fan when temperature along any one foot of element length falls below setpoint. Do not provide averaging element. Provide one foot of element for every square foot of AHU coil face area. Wire to shut down fan as specified in control sequences.

1. Thermostats in public and multi-occupancy areas shall have metal cover with tamperproof screws and satin chrome finish, with concealed adjustment, without thermometer.
2. Thermostats for private areas and single occupancy areas shall have open adjustment for use with key, exposed dial and accurate red-reading thermometer.
3. Transmitters shall have closed adjustments.
4. Heating/cooling thermostats shall be dead-band.

Q. Airflow Measurement:

1. Eliminator Series Engineers Guide Specification:
    a. Manufacturer.
    b. Base Bid: Ebtron Inc., Series 3000, Series 4000.
    c. Airflow and Temperature Measurement: Thermal anemometer using instrument grade self-heated thermistor sensors with thermistor temperature sensors. Flow measurement drift shall not exceed manufacturer’s repeatability statement for the life of the equipment.’ Manufacturer shall provide test data for accuracy performance prior to bid date. Vortex shedding arrays are not acceptable. Pilot tube and differential pressure sensing arrays are not acceptable. Auto zeroing sensors are not acceptable.
2. Ebtron Series 4000 Fan Inlet Sensor:
    a. Flow station construction.
    b. Type: Fan inlet.
    c. Sensors: Glass encapsulated self-heated thermistor and epoxy encapsulated

temperature sensor.

d. Sensor Housing: Noryl.

e. Sensors per inlet:

1) <12,000 CFM, 2 sensors.

2) >12,000 CFM, 4 sensors.

f. Support Struts: Tubular steel, adjustable to fit fan inlet.

g. Supporting Brackets: Steel

h. Electronics:

1) Type: Microprocessor based, totally solid-state.

2) Connecting Cable Flow Sensor to Electronics: Plenum rated, NEC Type CL2P.

3) Enclosure: Aluminum, indoor use only. (Option, Insert: NEMA, 4X outdoor use.)

i. Performance:

1) Flow station temperature range: 30 to 160° F.

2) Flow station velocity range: 0 to 10,000 ft./min.

3) Flow station humidity range: 0 to 99% RH (non-condensing).

4) Analog output signals 0-5 VDC, 0-10 VDC, 4-20mA:

a) Sensor velocity linearity: + 10 ft./min. < 500 ft./min., + 2% reading > 500 ft./min.

b) Sensor temperature accuracy: typ. 0.18 F, max. 0.36 F.

c) Type: Linear.

d) Repeatability: + 0.2% scale.

e) Resolution: 0.4% scale.

3. Ebtron Series 3000 Duct-Mounted Sensor:

a. Flow station construction.

b. Type: Duct-mounted.

c. Sensors: Glass encapsulated self-heated thermistor and epoxy encapsulated temperature sensor.

d. Sensor Housing: Noryl (option for corrosive environments, insert: Kynar).

e. Sensors per probe: 1 to 4.

f. Support Struts: Tubular Aluminum 6061 (option for corrosive environments, insert: 316 stainless steel).

g. Supporting Bracket: Aluminum 6063 (option for corrosive environments, insert: 304 stainless steel).

h. Electronics:

1) Type: Microprocessor based, totally solid-state.

2) Enclosure: Aluminum, indoor use only, (option, insert: NEMA 4X, outdoor use) (option for corrosive environments, insert: 304 stainless steel).

i. Performance:

1) Electronics temperature range: 30 to 160 F.

2) Flow station temperature range: 30 to 160 F.

3) Flow station velocity range: 0 to 5,000 ft./min.

4) Flow station pressure drop: less than 0.005 in wv @ 2000 ft. per min.

5) Flow station humidity range: 0 to 99% RH (non-condensing).

6) Analog output signals: 0-5 VDC, 0-10 VDC, 4-20mA.

a) Sensor velocity accuracy: + 10 ft./min. < 500 ft./min., +2% reading > 500 ft./min.

b) Sensor temperature accuracy: Type 0.18 F, max. 0.36 F.

7) Type: Linear.

8) Repeatability: +0.2% scale.

9) Resolution: 0.4% scale.

j. Flow Conditioners:

1) Provide Hexagon cell flow straightener as determined by airflow measuring station manufacturer when required to meet installation guidelines.

2) Construction: Aluminum frame, 2.75” thick, 0.75” cell, aluminum foil core.

k. Performance:

1) Pressure drop: <0.06 in w.c. at 2,000 ft./min.

R. CO2 monitoring/control system to control the outdoor air quantity.

1. Provide a CO2 monitoring/control system to control the outdoor air quantity.

2. Detection system shall include but not be limited to the following components.

a. Detection cell based on a non-dispersive infrared method which is not affected by humidity, duct or other gases.

b. A microprocessor based control module.

c. Detection range: 0-2000 PPM.

d. Single pole double throw relay with adjustable set point, factory preset at 850 PPM.

e. Hysteresis stop set at 100 PPM.

f. Two outputs: 0-10V and 4-20mA (linear).

g. LCD display.

3. Provide enclosure with sampling tube for installation in return air duct serving F-3.

4. Provide remote mounting LCD panel, sampling tubing, mounting hardware, etc. as required for a complete and operable system.

5. Alarm indicator or remote panel shall indicate high CO2 with both an audible and visual alarm. Alarm condition shall remain on until CO2 levels drop below the pre-set levels and/or until manually reset at the LDC display panel.

6. CO2 detection system shall be as manufactured by Vulcan, Brasch, Johnson Controls, or approved equal.

S. Point List: Submit complete point list of devices or elements to be controlled or senses by DCC system. Include sufficient detail to enable Architect to determine that DDC system can perform control sequence of operations listed on HVAC Drawings. Point count must contain at least:

1. List of every component to be sensed or controlled, keyed to terminology used in HVAC

Control Drawings; that is, Valve V-1, AHU-1, etc.

2. List of analog inputs to be sensed at each point; that is, temperature, relative humidity, etc.
3. Alarms associated with each point.
4. Control functions associated with each point; that is, start/stop, setpoint control, etc.

2.16 SEQUENCE OF OPERATIONS

A. Summary: This contractor shall coordinate control functions, such as scheduling and supervisory-level global control, points list, and control sequences needed for this installation as listed below. Contractor shall provide written documentation to archive the system operation as accepted by the Owner.

B. Variable Refrigerant Flow Heat Recovery System:

1. The system manufacturer shall provide a complete controls system to maintain space temperature set-point. Refer to equipment schedule for a list of equipment to be installed and programmed. Provide all sensors and wiring as required. The contractor shall install and program the system per the manufacturer's instructions. The new VRF controller shall be tied into Facility Control Management System (FCMS). Provide floor plans and graphics on FCMS. Provide graphics on FCMS and monitor all points provided by the equipment manufacture.

C. Provide and connect a condensate overflow switch device at each unit conforming to UL-508 to shut off the equipment in the event that the primary drain is blocked. The FCMS shall monitor shut off switch status.

D. Dedicated Outdoor Air Unit (DOAS): The unit manufacturer shall provide a controller to maintain supply air temperature set-points. The unit shall be off and outdoor air dampers shall be closed during the occupied mode. The heating and cooling shall cycle to maintain supply air temperature of 68 degrees F. (adjustable). The economizer mode and outdoor reset discharge setpoints shall be controlled and monitored at the FCMS. Refer to equipment schedule for a list of equipment to be installed and programmed. Provide all sensors and wiring as required. The contractor shall install and program the system per the manufacturer's instructions. The unit shall be programmed to run continuously during the occupied mode and shall shut down during un-occupied mode. On detection of smoke in the supply duct, alarm will be generated. On detection of smoke in the supply duct, unit will be shut down by hardwired interlock. Filter differential pressure and smoke detector are monitored, and respective alarms will be generated on detection of excessive filter differential pressure or smoke detection. The new DOAS controller shall be tied into Facility Control Management System (FCMS). Provide graphics on FCMS and monitor all points provided by the equipment manufacture.

1. Discharge Air Temperature Setpoint Active is reset by comparing the Space Temperature Active to Occupied Cooling Setpoint during cooling and Occupied Heating Setpoint during heating. If a single setpoint is preferred, use Space Temperature Setpoint BAS by putting it In Service using the FCMS.
2. Primary Heating Mode Discharge Air Control: Heating Mode is enabled whenever the Outdoor Air Temperature Active is below the Outdoor Air Heating Enable Setpoint. During Heating Mode, Heat Capacity is adjusted to maintain the Discharge Air Temperature Local to Discharge Air Temperature Setpoint Active.
3. Cooling Mode Discharge Air Control: Cooling Mode is enabled whenever the Outdoor Air Temperature Active rises above the Outdoor Air Cooling Enable Setpoint. The Outdoor Air Temperature Active must be above the Outdoor Air Heating Enable Setpoint. During Cooling Mode, Cooling Capacity is adjusted to maintain Discharge Air Temperature Setpoint Active.
4. Dehumidification Mode: Outdoor Air Dewpoint is calculated using Outdoor Air Temperature Active and Outdoor Air Humidity Active. Dehumidification Mode is enabled whenever the

Outdoor Air Dewpoint rises above the Outdoor Air Dewpoint Enable Setpoint. The Outdoor Air Temperature Active must be above Outdoor Air Heating Enable Setpoint. During Dehumidification Mode, Cooling Capacity is adjusted to maintain the Dehumidification Temperature Setpoint Active, which is written to by Dehumidification Temperature Setpoint (adjustable). Hot Gas Reheat Valve Command is adjusted to maintain Discharge Air Temperature Setpoint Active.

5. Energy Recovery Wheel Operation (ERV): The Energy Recovery Wheel Start Stop Command is enabled whenever there is a call for exhaust fan. During Ventilation Mode or Economizer Mode the ERV is disabled, except during the cleaning cycle, which occurs for two minutes every thirty minutes.

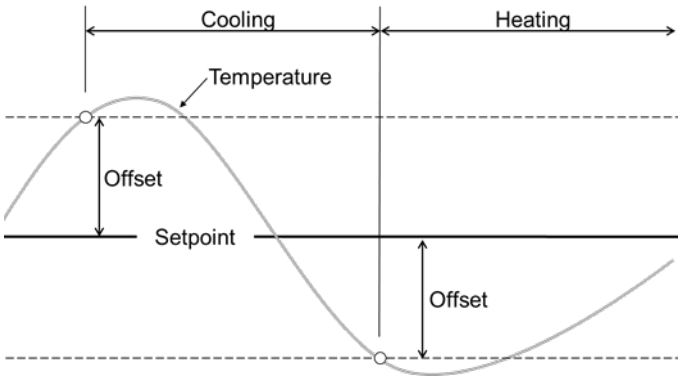


Figure 1. Heat Cool Mode Arbitration Graph.

PART 3 – EXECUTION

3.1 COMMISSIONING OF EQUIPMENT AND SYSTEMS

A. The Architect will check the completed installation either sequentially as different parts are completed, or when the entire installation is complete, at the sole option of the Architect.

B. Prior to the Architect's checking a part of the installation or the entire installation, this Contractor shall submit a letter signed by an Officer of this Contracting Company or an Officer of the General Contractor stating that:

1. He is an Officer of the Company.
2. He has personally inspected the installation to be checked.
3. The date of his inspection.
4. The installation is complete and tested and ready to be inspected by the Architect, and that all required test reports have been submitted.

C. This Contractor shall arrange that an Officer of this Contracting Company or of the General Contractor, as well as the Clerk of the Works, in addition to other test witnesses that may be specified, shall witness the below listed tests. At the conclusion of each such test this Contractor shall submit a letter signed by the Officer stating that:

1. He is an Officer of the Company.
2. He has personally witnessed the tests (giving the name of the tests).
3. The date of testing.
4. The results of testing, as compared to specified performance.
5. List the name, title and company affiliated to all those witnessing the tests.

Tests Requiring Letters:

Electrical:	Fire Alarm Emergency Lighting and Power Distribution
HVAC:	DOAS Operation and Controls Variable Refrigerant Flow System Operation and Controls Electric Heating Equipment operation and Controls

3.2 SPECIAL RESPONSIBILITIES

A. Coordination: Cooperate and coordinate with work of other Sections in executing work of this Section.

1. Perform work such that progress of entire project including work of other Sections shall not be interfered with or delayed.
2. Provide information as requested on items furnished under this Section which shall be installed under other Sections.
3. Obtain detailed installation information from manufacturers of equipment provided under this Section.
4. Obtain final roughing dimensions or other information as needed for complete installation of items furnished under other Sections or by Owner.
5. Keep fully informed as to shape, size and position of openings required for material or equipment to be provided under this and other Sections. Give full information so that openings required by work of this Section may be coordinated with other work and other openings and may be provided for in advance. In case of failure to provide sufficient information in proper time, provide cutting and patching or have same done, at own expense and to full satisfaction of Architect.
6. Provide information as requested as to sizes, number and locations of concrete housekeeping pads necessary for floor-mounted vibrating and rotating equipment provided under this Section.
7. Notify Architect of location and extent of existing piping, ductwork and equipment that interferes with new construction. In coordination with and with approval of Architect, relocate piping, ductwork and equipment to permit new work to be provided as required by Contract Documents. Remove non-functioning and abandoned piping, ductwork and equipment as directed by Architect. Dispose of or store items as requested by Architect.

B. Installation Only Items:

1. Where this Contractor is required to install items which it does not purchase, it shall coordinate their delivery and be responsible for this unloading from delivery vehicles and for their safe handling and field storage up to the time of installation. This trade shall be responsible for:
    a. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
    b. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building system.
2. This Contractor shall carefully examine such items upon delivery. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of work of this Contractor will be considered only if presented in writing within one (1) week of their date of delivery. Unless such claims have been

submitted this Contractor shall be fully responsible for the complete reconditioning or replacement of the damaged items.

C. Maintenance of equipment and Systems: Maintain HVAC equipment and systems until Final Acceptance. Ensure adequate protection of equipment and material during delivery, storage, installation and shutdown delays pending final test of systems and equipment because of seasonal conditions. Do not use boilers before providing water treatment where required; this includes use of boilers for temporary heat or for testing.

D. Use of Premises: Use of premises shall be restricted as directed by Architect and as required below:

1. Remove and dispose of dirt and debris, and keep premises reasonably clean. Upon completion of work, remove equipment and unused material. Put building and premises in neat and clean condition and do cleaning and washing required to provide acceptable appearance and operation of equipment, to satisfaction of Architect and as specified under CLEANING paragraph.

2. It shall be this trade's responsibility to store his material in a manner that will maintain an orderly clean appearance. If stored on-site in open or unprotected areas, all equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.

3. Do not interfere with functions of existing sewers and gas mains. Extreme care shall be observed to prevent debris from entering ductwork. Confer with Architect as to disruption of heating services or other utilities due to testing or connection of new work to existing. Interruption of heating services shall be performed at time of day or night deemed by Architect to provide minimum interference with normal operation. Obtain Architect's approval of the method proposed for minimizing service interruption.

E. Surveys and Measurements:

1. Base measurements, both horizontal and vertical, on reference points established by Contractor and be responsible for correct laying out of work.

2. In event of discrepancy between actual measurements and those indicated, notify Architect in writing and do not proceed with work until written instructions have been issued by Architect.

F. Fireproofing:

1. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible prior to start of spray fiber work.

2. Ducts, piping and other items, which would interfere with proper application of fireproofing, shall be installed after completion of spray fiber work.

3. Patching and repairing of spray fireproofing due to cutting or damaging to fireproofing during course of work specified under this Section shall be performed by installer of fireproofing and paid for by trade responsible for damage and shall not constitute grounds for an extra to Owner.

3.3 MATERIALS AND WORKMANSHIP

A. Work shall be neat and rectilinear. Ductwork and piping shall run concealed except in mechanical rooms and areas where no hung ceiling exists. Install material and equipment as required by manufacturers. Installation shall operate safely and without leakage, undue wear, noise, vibration, corrosion or water hammer. Work shall be properly and effectively protected, and pipe and duct openings shall be temporarily closed to prevent obstruction and damage before completion.

1. Except as specified otherwise, material and equipment shall be new. Provide supplies, appliances and connections necessary for complete and operational installation. Provide

components required or recommended by OSHA and applicable NFPA documents.

2. References to manufacturers and to catalog designation are intended to establish standards of quality for materials and performance but imply no further limitation of competitive bidding.
3. Finish of materials, components and equipment shall be as approved by Architect and shall be resistant to corrosion and weather as necessary.
4. Owner will not be responsible for material and equipment before testing and acceptance.

3.4 CONTINUITY OF SERVICES

A. Do not interrupt existing service without Owner's approval.

B. Schedule interruptions in advance, according to Owner's instructions. Submit, in writing, with request for interruption, methods proposed to minimize length of interruption.

C. Interruptions shall be scheduled at such times of day and work so that they have minimal impact on Owner's operations.

3.5 TAGS

A. Upon completion of work, attach engraved laminated tags to all valves (listed in the valve directory called for in the "Bulletins, Manuals and Instructions" paragraph of these Specifications) and all pieces of HVAC equipment (including but not limited to pumps, fans, air handlers, coils and all other equipment listed in the HVAC Schedules). Valve tags shall have black characters on white face, consecutively numbered and prefixed by letter "V". Equipment tags shall have black characters on white face with labels corresponding to drawing schedule numbers.

B. Embossed or engraved aluminum or brass tags may be substituted if desired. Tags shall be at least 1/8" thick.

C. Valve tags shall be at least 1" in diameter with numerals at least 3/8" high and attached by "S" hooks or chains. Equipment tags shall be at least 2" diameter securely attached to apparatus.

D. Provide manufacturers equipment nameplates, catalog numbers and rating identification securely attached to electrical and mechanical equipment with screws or rivets. Adhesives or cements will not be permitted.

3.6 PIPE AND DUCT IDENTIFICATION

A. Ductwork shall be stenciled at each junction or branch takeoff, at least once in each room, and at intervals not longer than 20 feet. Stencil shall clearly identify duct service ("S" for supply; "R" for return' "X" for exhaust), area served by branch, and arrow indicating direction of flow.

B. Provide color-coded pipe identification markers on piping installed under this Section. Pipe markers shall be snap-on laminated plastic protected by clear acrylic coating. Pipe markers shall be applied after architectural painting where such is required.

C. Provide arrow marker with each pipe content marker to indicate direction of flow. If flow can be in either direction, use double-headed arrow marker.

D. Mains shall be labeled at points of entrance and exit from mechanical room, adjacent to each valve, on each riser, at each tee fitting, at points of entrance and exit from building, at least once in each room and at intervals no longer than 20 feet.

E. Size of legend letters on markers and length of color field shall be per the latest edition of ANSI A13.1.

F. Markers shall be "Setmark" by Seton Name Plate Corp., or approved equal.

G. Following color-coding shall be used with names in black letters on background and while letters on green background:

Service	Legend	Background Color
Refrigerant Piping	REF	Green
Condensate	CW	Yellow

H. Color banding shall meet latest edition of ANSI A13.1 and OSHA.

3.7 ACCESS AND ACCESS PANELS

A. Provide proper access to materials and equipment that require inspection, replacement, repair or service and coordinate their delivery with the installing Trade. If proper access cannot be provided, confer with Architect as to best method of approach for minimizing effect of reduced access which may result.

B. Coordinate and prepare a location, size and function schedule of access panels required to fully service equipment and deliver to a representative of the installing Trade. Furnish and install distinctively colored buttons (color as selected by Architect) in finished ceiling to identify all access panels.

C. Furnish access panels for installation under other Sections where fire dampers, volume dampers, controls, shut-off valves, control valves, check valves or other items installed under this Section require access and are concealed in floor, wall, furred space or above ceiling. Access panels shall be by Milcor, Knapp, Nystrom or Inland Steel; coordinate selection with other Sections supplying similar access panels.

D. Ceilings consisting of lay-in or removable splined tiles do not require access panels and dampers, splitters or test hole openings above ceiling shall have location marked with thumb tack on finished ceiling panel. Location shall be noted on record Drawings.

E. Access panels shall have same fire-rating classification as surface penetrated.

F. Panels shall be at least 12” x 12”; access panels at equipment (VAV boxes, fan boxes and others) shall be 18” x 18”.

3.8 PENETRATIONS AND SLEEVES

A. General:

1. Provide pipe and duct sleeves and packing materials as specified and as shown on Drawings at penetrations of foundations, walls, slabs (except on-grade), partitions and floors. Sleeves shall meet NFPA-101 requirements and materials requirements of PART 2 or this Section.

2. Coordinate work carefully with architectural and structural work. Set sleeves in forms before concrete is poured. Provide core drilling as necessary if walls are poured, or otherwise constructed, without sleeves and a wall penetration is required. Provide core drilling as required for penetrations of existing construction. Do not penetrate structural members without Architect’s approval.

3. Sleeves for insulated pipe and duct in non-fire rated construction shall accommodate continuous insulation without compression. Sleeves and/or penetrations in fire-rated construction shall be packed with fire-rated material which shall maintain the fire rating of the wall. Seal ends of penetrations to provide continuous vapor barrier where insulation is interrupted. See “PART 2” of these Specifications for requirements for packing materials.

4. Sleeves through floor shall be water-tight and shall extend 2” above floor surface.

B. Pipe Sleeves:

1. Annular space between pipe and sleeve shall be at least 1/4".

2. Sleeves are not required for slabs-on-grade unless specified otherwise.

3. Sleeves and packing materials, through rated fire walls and smoke partitions shall maintain fire rating of construction penetrated.
4. Do not support piping risers on sleeves.

C. Duct Sleeves and Prepared Openings:

1. Provide duct sleeves for round ducts 15” and smaller; provide prepared, framed openings for round ducts larger than 15” and for square, rectangular and flat oval ducts, except as specified otherwise. Sleeves shall met SMACNA requirements.
2. Provide sleeves for ducts through 1, 2, or 3-hour fire-rated construction and smoke partitions, regardless of size and shape of ducts. Sleeves shall maintain fire rating of construction penetrated. Sleeve and seal materials, construction and clearances shall meet requirements of SMACNA Fire Damper and Heat Stop Guide for Air Handling Systems.
3. Prepared openings shall be framed to provide 1” clearance between framing and duct or duct insulation.

D. Installation Testing, Listings and Approvals:

1. Installation shall meet material manufacturer’s recommendations exactly, particularly as regarding safety, ventilation, removal of foreign materials and other details of installation. Dam openings as recommended. Remove flammable materials used for damming and forming seals in fire-rated construction.
2. Sleeve penetration methods shall be water and gas-tight and shall meet requirements of ASTM E-119 Standard Methods of Fire Tests of Building Construction and Materials.
3. Fire-stop penetration seal methods and materials shall be FM-approved and UL-listed as applicable.
4. Inspect foamed sealants to ensure manufacturer’s optimum cell structure and color ranges.

3.9 ANCHORS AND INSERTS

A. Inserts shall be iron or steel of type to receive machine bolt head or nut after installation. Inserts shall permit adjustment of bolt in one (1) horizontal direction and shall develop strength of bolt when installed in properly cured concrete.

B. Provide anchors as necessary for attachment of equipment supports and hangers.

3.10 INSTALLATION OF EQUIPMENT

A. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways to satisfaction of Architect and in accordance with code requirements. Installation shall permit clearance for access to equipment for repair, servicing and replacement.

B. Install equipment so as to properly distribute equipment loads on building structural members provided for equipment support under other Sections. Roof-mounted equipment shall be installed and supported on structural steel provided under other Sections.

C. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs as necessary for floor, wall or ceiling mounting of equipment provided under this Section (e.g. heating and ventilating units, fans, ducts and piping) as indicated on Drawings and in Specifications.

D. Provide steel supports and hardware for proper installation of hangers, anchors, guides, etc.

E. Provide cuts, weight and other pertinent data required for proper coordination of equipment support provisions and installation.

F. Structural steel and hardware shall conform to Standard Specifications of ASTM; use of steel and

hardware shall conform to requirements of Section 5 of Code of Practice of American Institute of Steel Construction.

G. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly which will void warrantee. Report in writing to Architect, prior to purchase or shipment of equipment involved, on conditions which may prevent proper installation.

3.11 CLEANING

A. Ductwork:

1. New ductwork shall be shipped from the shop to the job site with the ends of the ducts sealed tight with heavy duty plastic to prevent dirt, water or other elements from entering the ducts while in transport to the job site.
2. At the end of each working day all open ends of ducts that have been hung in place shall be re-covered with the plastic material to prevent the entry of foreign objects, dirt or debris into the ducts.
3. All ducts shall be cleaned of dirt and any other foreign matter if it should accumulate on or in the ducts prior to start-up and testing of the new HVAC systems. If the ducts do need to be blown clean, cheesecloth shall be placed over the outlet air openings, and the rooftop unit(s) serving the ducts shall be provided with temporary filters.

3.12 STARTUP, TESTING, ADJUSTING AND BALANCING FOR HVAC

A. General:

1. References:
   a. AABC – National Standards for Total System Balance.
   b. ADC – Test Code for Grilles, Registers, and Diffusers.
   c. ASHRAE 111 – Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilating, Air Conditioning and Refrigeration Systems.
   d. NEBB – Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
   e. SMACNA – HVAC Systems Testing, Adjusting, and Balancing.
2. Qualifications:
   a. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this section with minimum three years documented experience certified by AABC.
   b. Perform work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor.

B. Examination:

1. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   a. Systems are started and operating in a safe and normal condition.
   b. Control systems are installed complete and operable.
   c. Proper thermal overload protection is in place for electrical equipment.
   d. Ductwork systems:
      1) Final filters are clean and in place. If required, install temporary media in addition to

final filters.

2) Duct systems are clean of debris.

3) Fans are rotating correctly.

4) Dampers are in place and open.

5) Air coil fins are cleaned and combed.

6) Access doors are closed and duct end caps are in place.

7) Air inlets and outlets are installed and connected.

8) Duct system leakage is minimized.

2. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

3. Beginning of work means acceptance of existing conditions.

C. Preparation:

1. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Owner to facilitate spot checks during testing.

2. Provide additional balancing devices as required.

D. Installation Tolerances:

1. HVAC Systems: Adjust to within plus or minus 10 percent of design for supply and return systems and plus or minus 10 percent of design for exhaust systems.

2. Air Outlets and Inlets: Adjust outlets and inlets in space to within plus or minus 10 percent of design.

E. Adjusting:

1. Ensure recorded data represents actual measured or observed conditions.

2. Permanently mark settings of balancing devices allowing settings to be restored. Set and lock memory stops.

3. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

4. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. Sequencing:

1. All systems providing both heating and cooling shall be balanced in both modes of operation.

2. For all systems provide initial balancing to tolerances indicated in this section. After initial balancing readjust systems as directed by Engineer and Owner as necessary to achieve uniform space temperatures free from objectionable drafts and noises.

G. Air System Procedure:

1. Adjust equipment and distribution systems to provide required or design air quantities.

2. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

3. Measure and record air quantities at air inlets and outlets.

4. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Adjust air volume by adjusting duct internal

devices such as dampers and splatters. Do not utilized opposed blade dampers at air inlets and outlets.

5. Vary total system air quantities by adjusting sheave position or replacing fixed sheaves with larger or smaller diameter sheaves at each fan. Provide replacement fixed ratio sheaves and belts after final balancing selected to achieve design airflows. Vary branch air quantities by damper regulation.
6. Measure and record static air pressure conditions at air supply and exhaust units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
7. Adjust settings and minimum setpoints for motorized and backdraft dampers to design conditions.
8. Measure and record temperature conditions across dampers to check leakage.
9. Where modulating dampers are provided, take measurements and balance at extreme conditions.
10. Measure and record inlet and outlet temperatures at each air supply unit at full cooling and heating capacity.
11. Prepare system pressure profiles: On schematic fan system diagrams, show STATIC pressure readings taken at following points.
    a. Fan discharge
    b. Fan discharge plenum or main duct in fan room
    c. Fan inlet plenum
    d. Inlet and outlet plenum space on each side of each heating coil, cooling coil and filter
    e. Return air/outside air mixing plenum
    f. Duct or plenum immediately behind outside air louver
    g. Return/exhaust fan inlet
    h. Return/exhaust fan outlet
    i. Each main branch duct takeoff at each floor
    j. Within 3 feet of last supply air outlet connection in most remote duct.

H. Schedules:
1. Equipment requiring Testing, Adjusting, and Balancing including but not limited to:
    a. Dedicated Outdoor Air Unit
    b. Variable Refrigerant Flow System
    c. Air Handling Units
    d. Fans
    e. Air Inlets and Outlets

I. Report Forms:
1. Forms shall include the following:
    a. Title Page:
        1) Name of Testing, Adjusting, and Balancing Agency
        2) Address of Testing, Adjusting, and Balancing Agency

3) Telephone number of Testing, Adjusting, and Balancing Agency
4) Project name
5) Project location
6) Project Architect
7) Project Engineer
8) Project Contractor
9) Project altitude
10) Report date

b. All equipment shall include:
1) Manufacturer
2) Model/Size
3) Identification/Number
4) Serial Number

c. Summary Comments:
1) Design versus final performance
2) Notable characteristics of system
3) Description of systems operation sequence
4) Summary of outdoor and exhaust flows to indicated amount of building pressurization
5) Nomenclature used throughout report
6) Test conditions

d. Instrument List:
1) Instrument
2) Manufacturer
3) Model number
4) Serial number
5) Range
6) Calibration date

e. Electric Motors: (data for single and multispeed motors)
1) Manufacturer
2) Model/Frame
3) HP/BHP/efficiency
4) Phase, voltage, amperage; nameplate, actual, no load
5) RPM
6) Service factor
7) Starter size, rating, heater elements
8) Sheave Make/Size/Bore

f. Air Cooled Condensing Unit (HPU & HRU)
   1) Location
   2) Serial number
   3) Entering DB air temperature, design and actual
   4) Leaving DB air temperature, design and actual
   5) Number of compressors

g. Air Handling Units/ Rooftop Units:
   1) Location
   2) Arrangement/Class/Discharge
   3) Air flow, specified and actual
   4) Return air flow, specified and actual
   5) Outside air flow, specified and actual
   6) Total static pressure (total external), specified and actual
   7) Inlet pressure
   8) Discharge pressure
   9) Sheave Make/Size/Bore
   10) Number of Belts/Make/Size
   11) Fan RPM

h. Return Air/Outside Air Data:
   1) Identification/location
   2) Design air flow
   3) Actual air flow
   4) Design return air flow
   5) Actual return air flow
   6) Design outside air flow
   7) Actual outside air flow
   8) Return air temperature
   9) Outside air temperature
   10) Required mixed air temperature
   11) Actual mixed air temperature
   12) Design outside/return air ratio
   13) Actual outside/return air ratio

i. Exhaust/Supply Fan Data:
   1) Location
   2) Air flow, specified and actual
   3) External static pressure, specified and actual

4) Inlet pressure
5) Discharge pressure
6) Fan RPM

j. Duct Traverse:
1) System zone/branch
2) Duct size
3) Area
4) Design velocity
5) Design air flow
6) Test velocity
7) Test air flow
8) Duct static pressure
9) Air temperature
10) Air correction factor

k. Duct Leak Test:
1) Description of ductwork under test
2) Duct design operating pressure
3) Duct design test static pressure
4) Duct capacity, air flow
5) Maximum allowable leakage duct capacity times leak factor
6) Test apparatus
a) Blower
b) Orifice, tube size
c) Orifice size
d) Calibrated
7) Test static pressure
8) Test orifice differential pressure
9) Leakage

3.13 VRF SYSTEM PROJECT SUPERVISION

A. General:

1. VRF Manufacturer shall provide on-site Project Supervision as outlined in this Specification section, providing: onsite technical review of installed VRF systems, review of activities related to the installation of the VRF system, VRF system components and associated controls.

2. All Project Supervision field activities shall be completed by an employee of the VRF manufacturer whose primary job responsibilities are to provide direct technical support of their product; sales staff or in-house support staff are not permitted to complete this scope of work.

3. A factory certified representative may assist the VRF manufacturer's personnel in the completion of certain elements of work contained within this Specification. Activities completed by a Factory Certified Representative shall be supervised onsite by the VRF manufacturer. Certified representatives shall not be used in lieu of the manufacturer's personnel.
4. The installing contractor shall assist the VRF manufacturer, in their completion of the system review and have available onsite a technician with appropriate diagnostic tools, materials and equipment, as required, for the duration of the inspection process. The technician assisting the VRF manufacturer shall be fully licensed and insured to complete necessary duties as directed by the VRF manufacturer.
5. The installing contractor shall have been certified by the manufacturer to install VRF systems, having attended and successfully completed a minimum 3- day VRF Service & Installation course at an approved training facility. A copy of this certificate shall be presented to the VRF manufacturer prior to the commencement of installation activity.
6. VRF manufacturer shall provide [4] onsite visits during the course of the project's completion. Additional site visits, if requested, shall require approval by the Owner's Representative and will be billed accordingly.
7. Onsite visits shall be conducted at installation milestones noted below. The installing contractor is responsible to coordinate each visit at the appropriate milestone, giving the VRF manufacturer a minimum 2-week notice prior to each visit.
    a. Project milestones
        1) Project Kick Off meeting
        2) Site Visit at 25% project completion
        3) Site Visit at 50% project completion
        4) Final Inspection prior to Commissioning of the VRF System

B. Project Kick-Off:

1. A project kick-off meeting will be conducted with the installing contractor and appropriate parties with the sole purpose to review the installation of VRF systems being installed.
2. Kick-off meeting shall consisting of a single [4] hour meeting with the installing contractor. This meeting shall be completed at the project site and be executed at the beginning stages of the installation of VRF systems.
    a. Items to be reviewed during the Project kick-off meeting are:
        1) Presentation of Best Practices & Installation Requirements specific to the VRF system(s) being installed under this scope of work.
        2) Review of the project's mechanical design drawings related to the VRF systems being installed. Documents to be provided by the mechanical contractor.
        3) Review of VRF Manufacturers design selection software and system design schematic drawings for the system being installed Documents to be provided by the mechanical contractor.
        4) Discuss project activity related to the installation of VRF system components
        5) Establish clear path of communication and project support. Mechanical contractor shall designate an onsite point of contact for all field coordination activities.
3. The installing contractor shall obtain from the Engineer/Designer of the VRF system a copy of the most current electronic design file used in the design and engineering process of the VRF system being installed. This electronic design file shall have been completed on the VRF

Manufacturers software and is the mechanical contractor's responsibility to provide the most current as-built version of this file during the course of the projects installation.

4. The installing contractor shall provide the VRF manufacturer, for their use, a complete set of HVAC mechanical plans prior to the Kick off meeting. The mechanical contractor is responsible to updates these plans during the course of the project.

C. Site Visit:

1. Each site visit shall consist of a single visit, not exceeding an [8] hour period. All visits shall occur during regular business hours of 8:30AM-4PM, Monday thru Friday.
2. Activates to be completed during each Site-Visit are as follows:
    a. Meet with designated representative from the VRF installation contractor to discuss field activities and provide technical support related to the VRF systems.
    b. Review installed VRF systems for compliance with manufacturer's installation, service and engineering Specifications.
    c. Assist the contractor in updating the VRF Design software for as-built purposes and for calculating the appropriate refrigerant charge.
    d. Provide a field report identifying any installation issues requiring attention. Report shall provide detailed information containing:
        1) Issue reference number
        2) Priority Level of issue
        3) Equipment M# & Reference TAG#
        4) Status of issue
        5) Description of issue being identified
        6) Recommendation for corrective action
        7) Follow-up requirements, if required

D. Project Close Out Documents:

1. Documents completed during the project Supervision process shall be compiled and presented to the Owner's Representative at the completion of field activities.
2. Close out documentation shall include
    a. Project Supervision report outlining activities completed under this scope of work
    b. As-built VRF design file depicting Model numbers and BTU capacity ratings of equipment installed, refrigerant pipe size & connection lengths between each system component, calculated refrigerant charge.
    c. Issue report

E. Professional Solutions Contact information:

1. Contact your regions [MANUFACTURER] VRF installation and service manager for information and pricing related to services required under this projects scope of work.

3.14 VRF SYSTEM COMMISSIONING

A. General:

1. The VRF Manufacturer shall oversee and assist the installing contractor with the start-up and commissioning of VRF equipment as outlined below. This process will be completed in two phases. Phase one shall cover the Pre-Start-Up inspection process, Phase two will cover the

Physical Start-Up & Commissioning of Equipment.

2. All VRF System Commissioning activities shall be completed by an employee of the VRF manufacturer whose primary job responsibilities are to provide start up and commissioning of their products; sales staff or in-house support staffs are not permitted to complete this scope of work.
3. A factory certified representative may assist the VRF manufacturer's personnel in the completion of certain elements of work contained within this Specification. Activities completed by a Factory Certified Representative shall be supervised onsite by the VRF manufacturer. Certified representatives shall not be used in lieu of the manufacturer's personnel.
4. 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 approved training center. A copy of this certificate shall be presented as part of the VRF equipment submittal process.
5. The installing contractor shall assist the VRF manufacturer in their completion of the system review and have available a technician with appropriate diagnostic tools, materials and equipment, as required, for the duration of the inspection process. The technician shall be fully licensed and insured to complete necessary duties as directed under the supervision of the VRF manufacturer.
6. Upon completion of the Equipment Start-Up & VRF Commissioning process, the VRF manufacturer shall provide a formal report outlining the status of the system, in electronic format only. Contained within this report shall be copies of all field inspection reports, required action items and status, Manufacturers design software As-Built, equipment model & serial numbers.
7. Completion of the Equipment Start-Up and VRF Commissioning process shall verify that the VRF system has been installed per the Engineer's design intent and complies with the VRF manufacturers engineering and installation Specifications related to their equipment.
8. Compliance with federal, state and local codes as well as other authorities having jurisdictions are not part of this process and are the responsibility of the installing contractor.
9. Contact your regions [MANUFACTURER] VRF installation and service manager for information and pricing related to services required under this projects scope of work.

B. Pre Start-up Inspection:

1. Contractor shall employ the services of the VRF manufacturer to provide a comprehensive field review of the completed VRF system installation, prior to the physical start up and operation of equipment. Upon satisfaction that the system meets the VRF manufacturer's installation requirements and Specifications, the contractor shall be allowed to proceed with the physical start up and operation of equipment.
2. Prior to the pre-start-up inspection, all systems components shall be in a final state of readiness having been fully installed and awaiting inspection.
3. The installing contractor shall provide the VRF manufacturer a copy of the electronic design file used in the design and engineering process of the system being inspected. This electronic design file shall have been completed on software approved by the specified VRF manufacturer and shall have been updated to reflect as-built conditions.
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 an uninterrupted 24HR period, with acceptable change due to atmospheric conditions.
    a. A record of the pressure check process shall be recorded and tagged at the outdoor unit.

The tag shall contain the following information: date & time of pressure check start, fill pressure, outdoor temperature at start & stop, date & time of pressure check completion, and the person's full name & company information completing the pressure check.

b. The installing contractor shall engage the General Contractor as a witness of the pressure check process, confirming that all steps and procedures related to the pressure check where properly followed and that the system held the holding pressure of 600PSI for a period of 24hr hours, with acceptable change due to atmospheric conditions. Witness information, including full name, company name, title, phone number and signature shall be recorded on same pressure tag used by installing contractor.

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.
   a. Evacuation start & stop dates, times, and persons involved shall be recorded and tagged at the outdoor equipment.
   b. Installing contractor shall digitally capture a photo of the micron gauge reading, at the conclusion of the 1hr holding period, for each system and provide a copy to the VRF manufacturer. Each photo shall contain a tag providing the outdoor units Serial number.
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 VRF manufacturers design software.
   a. 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. Electronic recording of final DIP switches shall be provided as part of the commissioning report.
8. A comprehensive review and visual inspection shall be completed for each piece of equipment following a detailed check list, specific to the equipment being reviewed. A copy of the inspection report shall be provided as part of the manufacturers close out documentation. Any deficiencies found during the inspection process shall be brought to the attention of the installing contractor for corrective action. Any system components that are not accessible for proper inspection shall be noted as such.
9. Indoor Equipment report shall contain
   a. Model & Serial Number
   b. Equipment location
   c. Equipment Tag/Identification number
   d. Network Address & Port Assignment
   e. Digital recording of equipment settings
   f. Mounting/support method
   g. Seismic restraints used
   h. Proper service clearance provided
   i. Wiring and connection points are correct
   j. High voltage reading(s) within acceptable range

k. Low voltage reading(s) within acceptable range
l. Type of Remote Controller used and its location
m. Occupied space temperature sensing location
n. Air temperature readings within acceptable range
o. Condensate pump interlock method
p. Fan E.S.P. setting
q. Air Filter condition
r. Height differential setting in heat mode
s. Noise level acceptable
t. Refrigerant pipe connected and insulated properly
u. Condensate pipe connected and insulated properly
v. Condition of connected ductwork
w. Fresh air connected
x. Humidifier connected and checked
y. Review of air balance report complete
z. Other interlocked systems, i.e. baseboard heat, booster fan etc.

10. Outdoor Air Cooled equipment report shall contain:
    a. Model & Serial Number
    b. Equipment location
    c. Equipment Tag/Identification number
    d. Network Address & Port Assignment
    e. Digital recording of equipment settings
    f. Mounting/support method
    g. Seismic restraints used
    h. High Wind Tethering method
    i. Proper service clearance provided
    j. Defrost Condensate removal addressed
    k. Wiring and connection points are correct
    l. High voltage reading(s) within acceptable range
    m. Low voltage reading(s) within acceptable range
    n. Control Network settings
    o. Noise level setting
    p. Refrigerant pipe installed and insulated properly
    q. Low ambient operation settings

C. Physical Start-Up & Commissioning of Equipment:
    1. Upon proper equipment start up by the contractor, following the manufacturers guidelines and Specifications, an employee of the VRF manufacturer 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 and verifying proper response.

1) This process shall be digitally recorded and included as part of the close out documentation.

c. Electronically record a minimum of one-hour of operational data per refrigeration system.

d. Electronically record selector switch positions on all indoor and outdoor equipment.

e. The VRF manufacturer shall retain the electronically recorded data, collected during the start-up and equipment commissioning process, at a designated location within the US for future reference.

D. Close-Out Information:

1. The VRF manufacturer shall issue a System Performance report at the completion of all fieldwork. Contained within this report shall be an overview of the system performance, recommendations, field reports, all electronic data, and as-built design file.

E. VRF Equipment Warranty:

1. Having successfully completed the Pre-Inspection, Start-Up & Equipment Commissioning processes and fulfilling all requirements, as outlined in the VRF manufacturers Extended Warranty Process. Along with installing contractor being certified by the VRFR manufacturer to install VRF systems, having attended a minimum 3- day VRF Service & Installation course at an authorized training center.

2. The equipment shall be provided with the following warranty per the VRF manufacturer's warranty policy:

a. Compressor: 7-year part only

b. Parts: 5-years part only

c. Labor: no labor coverage provided by VRF Manufacturer.

3.15 VRF SYSTEM OWNER TRAINING AND TECHNICAL SUPPORT

A. The VRF manufacturer shall provide the Owner's Representative a minimum 16-hour VRF Operation and Maintenance training class covering systems installed under this scope of work.

B. Training program is to be provided at the time of Owner occupancy.

C. Owner shall provide a suitable location, onsite, to conduct the VRF Operation and Maintenance class.

D. Training material shall be provided to participants in electronic format.

E. Contact your region's [MANUFACTURER] VRF installation and service manager for information and pricing related to services required under this projects scope of work.

END OF SECTION 23 00 00

SECTION 26 00 00 – ELECTRICAL TABLE OF CONTENTS

SECTION 26 00 00 – ELECTRICAL

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS AND REFERENCES

A. Include “General Requirements” and applicable parts of Division 1 as part of this section.

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. Where paragraphs of this section conflict with similar paragraphs of Division 1, requirements of this section shall prevail.

C. Coordinate work with that of all other trades affecting, or affected by work of this section. Cooperate with such trades to assure the steady progress of all work under the Contract.

D. The Subcontractor shall be responsible for filing all documents, payment of all fees, and securing of all inspections and approvals necessary for the work of this section.

E. The Electrical Subcontractor shall carry in the Bid Price all Utility Company and Municipal back charges for all materials furnished and work performed by them in conjunction with this Contract and pay same to the respective agency upon demand. The Electrical Subcontractor shall not be entitled to additional compensation after the submittal of his bid price should he fail, for any reason, to obtain the total back charge costs to be incurred by the Local Utility Companies or Municipal Agencies.

1.2 DEFINITIONS

A. As used in this section, “provide” means “furnish and install”, and “POS” means “Provided Under Other Sections”.

B. As used in the Contract Drawings and Specifications for Electrical work, certain non-technical words shall be understood to have specific meanings as follows, regardless of indications to the contrary in the General Conditions of other documents governing the Electrical work.

1. “Furnish” means: Purchase and deliver to the project site complete with every necessary appurtenance and support, all as part of the Electrical work. Purchasing shall include payment of all sales taxes and other surcharges as may be required to assure that purchased item(s) are free of all liens, claims, or encumbrances.

2. “Install” means: Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the Electrical work.

3. “Provide” means: “Furnish” and “Install”.

4. “New” means: Manufactured within the past two (2) years and never before used.

C. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any electrical item in the Contract Drawings or Specifications for Electrical work carries with it the instruction to furnish, install and connect the item as part of the Electrical work, regardless of whether or not this instruction is explicitly stated.

D. It shall be understood that the Specifications and Drawings for Electrical work are complimentary and are to be taken together for a complete interpretation of the Electrical work except that indications on the Contract Drawings, which refer to an individual element of work, take precedence over the Specifications where they conflict.

1.3 SCOPE

A. Perform work and provide material 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 a complete and fully functional installation.

1. Primary electric service duct bank.

2. Secondary electric service including underground conduit bank and secondary service entrance feeders, from the utility company pad mounted transformer, building grounding electrode and main service disconnect.

3. Interior secondary distribution systems including main switchboard, all distribution panelboards, motor controls, motor control centers, magnetic starters, overcurrent and switching devices, panelboards, raceways, cables, wiring, junction and pull boxes, wireways, and all other components required for complete electrical distribution system.

4. All lighting systems (indoor and outdoor, normal, night, emergency and exit) including all fixtures, lamps, mounting accessories, switches, controls, outlets, wiring, raceways, and all other components and fittings required for a complete lighting system.

5. Grounding and bonding of all electrical systems and equipment.

6. Fire alarm system complete with all devices and wiring including municipal connections.

7. Wiring devices (switches and receptacles) complete with associated wallplates.

8. Power wiring to HVAC, plumbing and fire protection equipment.

9. Testing of all electrical systems.

10. Access panels (furnish only).

11. Coordination between electrical and other trades.

12. Lighting control and dimming system.

13. All other systems hereinafter specified or indicated on the Contract Drawings, complete, leaving ready an electrical system in perfect operating condition.

14. All required staging and scaffolding of any height.

B. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

C. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties

that will affect work of this Section. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by an experienced observer. Site visit is particularly important because this is renovation work.

D. Before starting work in a particular area of the project, visit site and examine conditions under which work must be performed including preparatory work done under other Sections or Contracts or by Owner. Report conditions that might affect work adversely in writing through Contractor to Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing and preparatory work.

1.4 RELATED WORK UNDER OTHER SECTIONS

A. The following items are not included in this section and will be performed under the designated sections.

1. Temporary Facilities.
2. Earthwork: Excavation and backfill.
3. Concrete:
   a. Equipment foundations.
   b. Housekeeping pads.
   c. Concrete encasement for conduit banks.
   d. Rebar for items “a, b and c” above.
4. Masonry: All openings in masonry walls.
5. Waterproofing, Dampproofing and Caulking.
6. Roofing and Flashing.
7. Painting: All painting except as specified herein.
8. Finish Carpentry and Millwork.
9. Steel Doors and Frames.
10. Finish Hardware.
11. Fire Protection.
12. Plumbing.
13. HVAC.

1.5 REGULATORY REQUIREMENTS

A. Comply with all applicable Federal and State laws, and all Local Codes, By-laws and Ordinances.

B. Where provisions of the Contract Documents conflict with any codes, rules or regulations, the latter shall govern. Where the contract requirements are in excess of applicable codes, rules or

regulations, the contract provisions shall govern unless the Architect rules otherwise.

C. Request inspections from Authorities Having Jurisdiction, obtain all permits and pay for all fees and inspection certificates as applicable and/or required. All permits and certificates shall be turned over to the Owners at the completion of the work. Copies of permits shall be given to the resident engineer prior to the start of work.

D. Unless otherwise specified or indicated, materials and workmanship and equipment performance shall conform with the latest edition of the following standards, codes, Specifications, requirements and regulations:

1. State Building Code.

2. State Electrical Code.

3. National Fire Protection Association (NFPA).

4. Local Town Regulations and By-Laws.

5. Underwriter's Laboratories, Inc. (UL).

6. National Electrical Manufacturer's Association (NEMA).

7. American National Standards Institute (ANSI).

E. All Electrical work shall meet or exceed any other state and local codes and/or Authorities Having Jurisdiction including all other standards indicated herein.

1.6 SUBMITTALS

A. This paragraph shall supplement Division 1.

B. Definitions:

1. Shop Drawings: Information prepared by the Contractor to illustrate portions of the work in more detail than shown in the Contract Documents.

2. Coordination Drawings: Detailed, large-scale layout Shop Drawings showing HVAC, Electrical, Plumbing and Fire Protection work superimposed to identify conflicts and ensure inter-coordination of Mechanical, Electrical, Architectural, Structural and other work.

3. Manufacturer's Product Data: Information prepared by the manufacturer which depicts standard equipment.

C. Submittals, Procedures and Format:

1. Review submittal packages for compliance with Contract Documents and then submit to Architect for review. Submit transparency and two (2) blue or black-line reproductions of each Shop Drawing larger than 8-1/2" x 11". Submit eight (8) sets of each smaller shop drawing. After review, transparency original of each large Shop Drawing and six (6) sets of each small shop drawing will be returned with reviewer's marks. Electronically submitted shop drawings are acceptable.

2. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate

on cover sheet, the following information:

a. Title.

b. Name and location of project.

c. Names of Architect, Engineer, Contractor and Subcontractor(s).

d. Names of Manufacturer, Supplier, Vendor, etc.

e. Date of submittal.

f. Whether original submittal or resubmitted.

3. Shop Drawings and/or Manufacturer's Product Data shall contain detailed dimensional Drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data alone is not acceptable), electrical requirements and wiring diagrams. 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.

D. Acceptable Manufacturers:

1. The Architect's Mechanical/Electrical design for each project is based on the single manufacturer listed in the schedule or shown on the Contract Drawings. In Division 26 of these Specifications certain "Alternate Manufacturers" are listed 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.

b. Have identical operating characteristics to those called for in the Specifications.

c. Fit within the available space it was designed for, including space for maintenance and component removal, with no modifications to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the Contract Documents. The fact that a manufacturer's name appears as acceptable shall not be taken to mean the Architect has determined that the Manufacturer's products will fit within the available space. This determination is solely the responsibility of the Contractor.

d. For equipment mounted in areas where structural matters are a consideration, the products must have a weight no greater than the product listed in the schedules or Specifications.

e. Products must adhere to all architectural considerations including, but not limited to, being the same size and of the same physical appearance as scheduled or specified products.

E. Substitutions: Substitution of products by manufacturers other than those listed shall only be done in accordance with subparagraph "F" "Substitutions and Deviations".

F. Substitutions and Deviations:

1. Deviations from the Contract Documents and the substitution of materials or equipment relative to the "Acceptable Manufacturers" referred to above 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 substitution or deviation to the attention of the Architect. The letter shall describe changes in the system shown and physical characteristics (connections to adjacent materials, electrical services, service access

requirements, and other characteristics), and differences in operating characteristics or cycles.

2. Without letters flagging the substitution or deviation to the Architect, it is possible that the Architect may not notice such substitution or deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Architect, the Contractor shall hold the Architect and his consultants harmless for any and all adverse consequences resulting from the deviations being implemented. Adverse consequences shall include, but not be limited to, excessive noise, excessive maintenance, shortened longevity, spatial coordination problems, and inadequate performance versus scheduled design. This shall apply regardless of whether the Architect has reviewed or approved Shop Drawings containing the deviation, and will be strictly enforced.

3. Do not request substitute materials or equipment unless identical material or equipment has been operated successfully for at least three (3) consecutive years. Such materials and equipment shall be a regular cataloged item shown in the current catalog of the manufacturer. When deviation or substitution is permitted, coordinate fully with related changes to Architectural, Structural, Plumbing, Fire Protection, Mechanical, and other work. Ensure that related changes necessary for coordination of substituted items are made within the Contract Price. Assume full responsibility for safety, operation and performance of the altered system. Any extra costs incurred to the project based on the use of alternate manufacturers shall be borne by the Contractor who has requested the substitution.

4. Substitutions of equipment, systems, etc. requiring approval of local Authorities must comply with such regulations and be filed by the Contractor (should filing be necessary).

5. Consideration will not be given to claims that the substituted item meets the performance requirements with lesser construction. Performance, as delineated in schedules and in the Specifications, shall be interpreted as minimum performance.

6. Approval of proposed deviations or substitutions, if any, will be made at discretion of Architect.

7. If equipment is proposed for substitution that is not tested and rated according to industry-wide standards, the Architect shall have the right to have performance tests completed, at the Contractor's expense, to confirm the manufacturer's performance claims.

G. Submittal Notations: Submittals will be returned from the Architect marked as illustrated below:

□ NO EXCEPTION TAKEN	□ ACCEPTED AS NOTED
□ NOT ACCEPTED	□ REVISE AND RESUBMIT

1. Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the Contract Drawings and Specifications. Contractor is responsible for dimensions which shall be confirmed and correlated at the job site; fabrication process and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.

H. Schedule: Incorporate the Shop Drawing review period into the construction schedule so that work is not delayed. Contractor shall assume full responsibility for delays caused by not incorporating the following Shop Drawing review time requirements into his project schedule.

Allow at least ten (10) working days, exclusive of transmittal time, for review each time Shop Drawing is submitted or resubmitted with the exception that fifteen (15) working days, exclusive of transmittal time, are required for the following:

1. Motor control wiring diagram submittals.

2. Coordination Drawings, if required by this Specification.

3. If more than five (5) Shop Drawings of this trade are received in one (1) calendar week.

I. List of Proposed Equipment and Materials: Within four (4) weeks after Award of Contract and before ordering materials or equipment, submit a complete list of proposed materials and equipment and indicate manufacturer's names and addresses. No consideration will be given to partial lists submitted out of sequence.

J. Responsibility:

1. The intent of submittal review is to check for capacity, rating, and certain construction features. Contractor shall ensure that work meets requirements of the 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 submittals marked "REVIEWED" to extent that they agree with the 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 the Contract Documents. The Architect's noting of some errors while overlooking others will not excuse the Contractor for proceeding in error. Contract Document requirements are not limited, waived, nor superseded in any way by review.

2. Inform Subcontractors, Manufacturers, Suppliers, etc., of scope and limited nature of review process and enforce compliance with the Contract Documents.

K. Material and equipment requiring Shop Drawing and/or Manufacturer's Data Submittals shall include but not be limited to:

1. Light fixtures.

2. Switchboard and motor controls.

3. Panelboards.

4. Overcurrent and switching devices.

5. Wiring devices and wall plates.

6. Fire alarm system with wiring diagram and schedule.

7. Wiring and cables.

8. Conduit.

9. Boxes and fittings.

10. Safety switches.

11. Lighting control system.

1.7 SURVEYS AND MEASUREMENTS

A. Base all required measurements, both horizontal and vertical, on reference points established by the General Contractor and be responsible for the correct laying out of the Electrical work. In the event of a discrepancy between actual measurements and those indicated, notify the General Contractor in writing. Do not proceed with the work required until written instructions have been issued by the General Contractor.

1.8 COORDINATION

A. HVAC, Plumbing, Fire Protection, and Electrical Drawings are diagrammatic. They indicate general arrangements of Mechanical and Electrical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with Structural and other trades and to meet Architectural requirements.

B. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow speedy and efficient completion of the work.

C. Furnish to other trades advance information on locations and sizes of all frames, boxes, sleeves and openings needed for their work. Furnish information and Shop Drawings necessary to allow trades affected by the work to install their work properly and without delay.

D. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated, request information from Architect. Where the Electrical work shall interfere with the work of other trades, assist in coordinating the space conditions to make satisfactory adjustments before installation. Without extra cost to the Owners, make reasonable modifications to the work as required by normal Structural interferences. Pay the General Contractor for additional openings, or relocating and/or enlarging existing openings through concrete floors, walls, beams and roof required for any work which was not properly coordinated. Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside of structure as possible.

E. If any Electrical 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 trades involved without extra cost to the Owners.

F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

G. Protect all materials and work of other trades from damage which may be caused by the Electrical work, and repair all damages without extra cost to the Owners.

1.9 MECHANICAL AND ELECTRICAL COORDINATION

A. The HVAC Subcontractor shall furnish and install various electrical items relating to the heating and ventilating equipment and control apparatus. The Electrical Subcontractor shall be required to connect power wiring to this equipment unless noted otherwise.

B. The HVAC and Electrical Subcontractors shall coordinate their respective portions of the work, as well as the electrical characteristics of the heating, ventilating and air conditioning equipment.

C. All power wiring and local disconnect switches will be provided by the Electrical Subcontractor for the line voltage power. All control and interlocking wiring shall be the responsibility of the HVAC Subcontractor.

D. 120V and above power wiring sources extended and connected to HVAC control panels, transformers and switches shall be the responsibility of the Electrical Subcontractor. All low voltage thermostat, and any switch wiring shall be the responsibility of the HVAC Subcontractor.

E. Temperature control and equipment wiring shall be installed by the Heating and Ventilating Subcontractor.

F. Pipe heat tracing shall be furnished and installed by the Plumbing Subcontractor. Power connections shall be by the Electrical Subcontractor.

G. The Electrical Subcontractor will provide all magnetic starters except those furnished as an integral part of packaged equipment.

1.10 COORDINATION DRAWINGS

A. Coordination Drawings:

1. The Sheetmetal Subcontractor shall prepare a complete set of 3D model electronic Drawings at a scale not less than 3/8” equals 1’-0”, showing structure and other information as needed for coordination. He shall show sheetmetal layout thereon. These will be the Coordination Drawings.

2. The main paths of egress and for equipment removal, from main Mechanical, Electrical, Plumbing and Fire Protection rooms must be clearly shown on the Coordination Drawings. All fire and smoke partitions must be highlighted on the Coordination Drawings for appropriate coordination.

3. Each of the below specialty trades shall add its work to these background Drawings with appropriate elevations and grid dimensions. Specialty trade information is required for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers, and for spaces in and above ceilings where congestion of work may occur such as corridors, and even entire floors. Drawings shall indicate horizontal and vertical dimensions, to avoid interference with structural framing, ceilings, partitions, and other services.

   a. Specialty Trades:

      1) Plumbing System.

      2) HVAC Piping and Associated Control System.

      3) Electrical.

      4) Sheet Metal Work.

      5) Sprinkler System.

4. Each specialty trade shall sign and date each electronic Coordination Drawing. Return Drawings to the Sheetmetal Subcontractor, who shall route them sequentially to all specialty trades.

5. Where conflicts occur with placement of materials of various trades, the Sheetmetal Subcontractor will be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialed and dated by the specialty trade. The

Sheetmetal Subcontractor shall then final date and sign each Coordination Drawing. If he cannot resolve conflicts, the decision of the General Contractor shall be final, subject to the approval of the Architect.

6. A Subcontractor who fails to promptly review and incorporate his work on the Coordination Drawings shall assume full responsibility of any installation conflicts affecting his work and of any schedule ramifications.

7. The Sheetmetal Subcontractor shall make electronic copies of all Coordination Drawings. Fabrication shall not start until such electronic Drawings are received by the Architect/Engineer and have been reviewed.

8. Review of Coordination Drawings shall not diminish responsibility under this Contract for final coordination of installation and maintenance clearances of all systems and equipment with Architectural, Structural, Mechanical, Electrical, Plumbing and Fire Protection Contractors.

1.11 INSTALLATION REQUIREMENTS

A. The arrangement of all Electrical work shown on the Contract Drawings is diagrammatic only and indicates the minimum requirements of the work. Conditions at the building including actual measurements shall determine the details of the installation. All work shall be laid out and installed so as to require the least amount of cutting and patching.

B. Review the Architectural Drawings and Specifications before ordering any material and equipment. Any discrepancies shall be brought to the attention of the Architect for his determination prior to proceeding with the work.

1.12 TYPICAL DETAILS

A. Typical details where shown on the Contract Drawings shall apply to each and every item of the project where such items are applicable. They are not repeated in full on the Contract Drawings, which in many cases are diagrammatic only, but with the intention that such details shall be incorporated in full. Any alternate method proposed for use by the Contractor shall have the prior approval of the Architect.

1.13 SLEEVES, INSERTS

A. Furnish and install all sleeves, inserts, anchor bolts and similar items to be set into masonry or concrete, as required for Mechanical and Electrical work. Internal diameter of sleeve ball shall be 1/2" larger than the outside diameter of the pipe or insulation covered line passing through it.

1.14 CORING, DRILLING

A. Core, cut and/or drill all small holes 4.5” diameter or less in walls, floors and ceiling required for the installation of sleeves, supports, and conduit for the Electrical work.

1.15 FIRESTOPPING, SMOKEPROOFING AND WATERPROOFING

A. All penetrations made through fire rated assemblies (structures or partitions) shall be completely and properly fire sealed with the appropriate firestop systems installed in accordance with the Manufacturer’s recommendations. The firestop material UL listed fire rating shall match or exceed the fire rated assemblies. Verify with Architect if project is utilizing a specified product. If not, provide product manufactured by Hilti, Nelson or STI.

B. Provide waterproofing of all materials which penetrate a floor, exterior wall, slab or roof. All sleeves shall extend a minimum of 3 inches above floor or roof. All penetrations thru building foundation walls shall utilize Link-Seal products or approved equal.

C. All device, outlet and junction boxes installed within fire rated walls or ceilings shall be provided with a fire rated moldable putty pad. The putty pad shall be a one component, ready to use, intumescent elastomer capable of expanding a minimum of 3 times a 1000°F and the material shall be suitable for overhead, vertical and horizontal fire steps. The putty shall be listed by an independent testing agency such as U.L. or FM and shall meet or exceed the requirements of the applicable sections of the IBC, NFPA 5000, NEC & NFPA 101. Provide 3M fire barrier moldable putty pads MPP+ approved equal.

1.16 COMMISSIONING OF SYSTEMS

A. Provide the services of a factory authorized technician to instruct and direct the Owner in the operation and maintenance of indicated systems and/or equipment. Cost of such instruction shall be for a minimum of five (5) days for Electrical Contractor to assist in operation and troubleshooting of system. Technicians for each system shall be available for a minimum of four (4) hours. The Electrical Subcontractor shall be available throughout the entire Commissioning Phase to operate the systems/equipment. Systems and/or equipment that shall be commissioned include the following:

1. Panelboards.
2. Circuit breaker.
3. Disconnect switches.
4. Toggle switches.
5. Occupancy/Vacancy sensors.
6. Lighting Control systems.
7. Fire Alarm systems.
8. Motor controls.
9. Surge protection devices.

B. Upon completion of all tests, the Electrical Subcontractor shall repair and/or replace any defective equipment. Once replaced and/or repaired, all Commissioning shall be performed.

C. Refer to Section 26 00 00 paragraph 3.2 for additional requirements.

1.17 ACCESSIBILITY

A. Install all work such that parts requiring periodic inspection, operation, maintenance and repair are readily accessible.

B. Furnish all access panels appropriate to particular conditions, to be installed by trades having responsibility for the construction of actual walls, floors or ceilings at required locations.

1.18 SUPPLEMENTARY SUPPORTING STEEL

A. Provide all supplementary (non-structural) steelwork required for mounting or supporting equipment and materials.

B. Steelwork shall be firmly connected to building construction as required. Locations and methods of attachment shall be approved by the Architect.

C. Steelwork shall be of sufficient strength to allow only minimum deflection in conformity with manufacturer's published requirements.

D. All supplementary steelwork shall be installed in a neat and workmanlike manner parallel to floor, wall and ceiling construction: all turns shall be made at forty-five and ninety degrees, and/or as dictated by construction and installation conditions.

E. All manufactured steel parts and fittings shall be galvanized.

1.19 TOOLS AND EQUIPMENT

A. Provide all tools and equipment required for the fabrication and installation of the Mechanical and Electrical equipment at the site.

1.20 PORTABLE AND DETACHABLE PARTS

A. Contractors shall retain in their possession all portable and/or detachable parts and portions of materials, devices, equipment, etc. necessary for the proper operation and maintenance of the Mechanical and Electrical systems until final completion of the work, at which time they shall be handed over to the Owners.

1.21 RECORD DRAWINGS, PROJECT CLOSEOUT

A. As work progresses and for the duration of Contract, maintain a complete and separate set of prints of Contract Drawings at job site at all times. Record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to the original design. Work shall be updated on a weekly basis and shall be made available for review by Architect. Failure to perform this work shall be reason for withholding requisition payments. In addition, take photographs of all concealed equipment in gypsum board ceilings, shafts, and other concealed, inaccessible work. At completion of work, make copies of photographs with written explanation on back. These shall become part of Record Documents.

B. At completion of work prepare a complete set of Record Drawings utilizing AutoCAD produced drawings showing all systems as actually installed, including all fire alarm and electrical circuitry. Submit three (3) sets of prints to Architect for comments as to compliance with this section.

C. The Architect will not certify the accuracy of the Record Drawings. This is the sole responsibility of the Electrical Contractor.

D. This trade shall submit the Record Drawings for approval by the Fire and Building Departments in a form acceptable to the departments, when required by the jurisdiction.

E. Record Drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer, make and model numbers of final equipment installation.

1.22 GUARANTEE/WARRANTY

A. Guarantee and 24 Hour Service:

1. Guarantee Work of this Section in writing for not less than one (1) year following the date of acceptance by the Owner. If the equipment is used for temporary power etc, prior to acceptance by the Owner, the bid price shall include an extended period of warranty covering the one (1) year of occupancy, starting from the date of acceptance by the Owner. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to the Architect's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

2. In addition to guarantee requirements of Division 1 and of Subparagraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.

3. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the warranty period, the affected part or parts shall be replaced by this Contractor without any reimbursement.

4. Replace material and equipment that require excessive service during guarantee period as defined and as directed by Architect.

5. Provide 24 hour service beginning on the date the project is accepted by the Owner, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at no cost to the Owner. Service can be provided by this Contractor or a separate service organization. Choice of service organization shall be subject to Architect and Owner approval. Submit name and a phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

6. Submit copies of equipment and material warranties to Architect before final payment.

7. At end of guarantee period, transfer manufacturer's equipment and material warranties still in force to Owner.

8. This paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.

9. PART 2 paragraphs of this Specification may specify warranty requirements that exceed those of this paragraph. Those paragraphs shall govern.

10. Use of systems provided under this Section for temporary services and facilities shall not constitute Final Acceptance of Work by Owner, and shall not initiate the guarantee period.

11. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise the Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. The Architect and/or Engineer will direct course of action.

1.23 OPERATING, INSTRUCTION AND MAINTENANCE MANUALS

A. Refer to Section 017000 – CONTRACT CLOSEOUT for submittal procedures pertaining to operating and maintenance manuals.

B. Each copy of the approved operating and maintenance manual shall contain copies of approved Shop Drawings, equipment literature, cuts, bulletins, details, equipment and engineering data sheets and typewritten instructions relative to the care and maintenance for the operation of the equipment, all properly indexed. Each manual shall have the following minimum contents:

1. Table of Contents.

2. Introduction:
   a. Explanation of manual and its purpose and use.
   b. Description of the electrical systems.
   c. Safety precautions necessary for equipment.
   d. Illustrations, schematics and diagrams.
   e. Installation drawing.

3. Maintenance:
   a. Maintenance and lubricating instructions.
   b. Replacement charts.
   c. Trouble-shooting charts for equipment components.
   d. Testing instructions for each typical component.
   e. Two (2) typed sets of instructions for ordering spare parts. Each set shall include name, price, telephone number and address of where they may be obtained.

4. Manufacturer's Literature:
   a. The equipment for which Shop Drawings have been submitted and approved.

1.24 SERVICE CHARACTERISTICS

A. Primary Utility Voltage: 13.8 kv

B. Secondary Building Voltage: 120/208.

C. All equipment and wiring shall be suitable for the applied voltage.

1.25 QUALITY ASSURANCE

A. The requirements of the State Building Code and Local regulations establish the minimum acceptable quality of workmanship and materials, and all work shall conform thereto unless more stringent requirements are indicated or specified herein.

B. All work shall comply with the latest editions of the codes as referenced herein.

C. Follow manufacturer's directions for articles furnished, in addition to directions shown on Drawings or specified herein.

D. Protect all work, materials, and equipment from damage during process of work. Replace all damaged or defective work, materials and equipment without additional cost to the Owner.

E. All equipment and materials for permanent installation shall be the products of recognized manufacturers and shall be new.

F. Equipment and materials shall:

1. Where normally subject to Underwriters Laboratory Inc. listing or labeling services, be so listed and labeled.

2. Be without blemish or defect.

3. Not be used for temporary light and power purposes.

4. Be in accordance with the latest applicable NEMA standards.

5. Buy products which will meet with the acceptance of all Authorities Having Jurisdiction over the work. Where such acceptance is contingent upon having the products examined, tested and certified by Underwriters or other recognized testing laboratory, the product shall be so examined, tested and certified.

G. Except for conduit, conduit fittings, outlet boxes, wire and cable, all items of equipment or material of one generic type shall be the product of one manufacturer throughout.

H. For items which are to be installed but not purchased as part of the Electrical work, the Electrical work shall include:

1. The coordination of their delivery.

2. Their unloading from delivery trucks driven into any point on the property line at grade level.

3. Their safe handling and field storage until the time of permanent placement in the project.

4. The correction of any damage, defacement or corrosion to which they may have been subjected. Replacement, if necessary, shall be coordinated with the Contractor who originally purchased the item.

5. Field erection and internal wiring as necessary for their proper operation.

6. Mounting in place, including the purchase and installation of all dunnage, supporting members, and fastenings, necessary to adapt them to architectural and structural conditions.

I. Items which are to be installed but not purchased as part of the electric work shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the electric work will be considered only if presented in writing within one (1) week of the date of delivery to the project of the items in question. The electric work includes all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

1.26 DELIVERY, STORAGE AND HANDLING

A. All materials for the work of this section shall be delivered, stored and handled so as to preclude damage of any nature. Manufactured materials shall be delivered and stored in their original containers, plainly marked with the products' and manufacturer's name. Materials in broken containers or in packages showing watermarks or other evidence of damage, shall not be used and shall be removed from the site.

1.27 TEMPORARY POWER AND LIGHTING

A. The Electrical Subcontractor shall furnish and install feeders of sufficient size from the Utility Company's power lines for the electric light and power requirements for the building while under construction and until the permanent feeders and related equipment have been installed and are in operation. Temporary lighting shall be based on a minimum of one watt per square foot covering each and every square foot of floor area in the building. Sufficient wiring, lamps, and outlets shall be installed to insure proper lighting in all rooms, space, stairwells, and corridors. Minimum sized lamp used shall be 100 watt. Where higher lighting intensities are required by Federal or State Standards of Laws or otherwise specified, the above specified wattage shall be increased to provide these increased intensities.

B. All necessary transformers, meters, cables, panelboards, switches, temporary lamp replacements and accessories required for the temporary light and power installation shall be provided by the Electrical Subcontractor.

C. The Electrical Subcontractor shall provide and maintain on each floor of the building, a feeder or feeders of sufficient capacity for the requirements of the entire floor and he shall provide a sufficient number of outlets, located at convenient points so that extension cords of not over 50 feet in length will reach all work requiring temporary light or power.

D. The Electrical Subcontractor shall install and maintain the wiring and accessories for the offices of the General Contractor and the Clerk of the Works as specified in the contract form.

E. All temporary Electrical work shall meet the requirements of the National Electrical Code Article 590 Temporary Wiring, the Local Utility Company, and all Federal Standards and Laws.

F. All temporary wiring and accessories thereto installed by the Electrical Subcontractor shall be removed after their purposes have been served.

G. The General Contractor will pay for the cost of electric energy consumed by himself and by all of his Subcontractors, unless otherwise indicated.

H. All lamps installed in permanent lighting fixtures and used for lighting during construction shall be replaced by the Electrical Subcontractor just prior to date of Use and Occupancy or Final Acceptance.

I. Provide all temporary lighting and power required above during the normal working hours of the project or a total of ten (10) hours per normal working day; Saturdays, Sundays and legal holidays are excluded. The ten hours per day shall include manning the temporary power and lighting 1/2 hour before and 1/2 hour after a normal eight (8) hour working day. In addition to the above, provide and maintain, to the satisfaction of the local Authorities Having Jurisdiction, all temporary lighting and power that may be required for safety purposes. The Electrical Subcontractor will be compensated by the General Contractor for any additional standby time, materials or equipment required by the General Contractor or other Subcontractors beyond the normal working hours, as defined above.

1.28 STAGING AND SCAFFOLDING

A. Provide staging and scaffolding for all the work of this section complying with Division 1 requirements.

1.29 EXTRA MATERIALS

A. Furnish extra materials as indicated below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1. 10% of each total circuit breakers installed.

2. 10% of each total fuses installed.

3. Ten (10) toggle switches, duplex receptacles and associated wall plates.

4. 10% of total audio/visual appliances installed.

5. 10% of each total pull stations and smoke detectors installed.

6. Five (5) of each ceiling mounted occupancy or vacancy sensor and associated power pack installed.

7. Five (5) of each wall mounted occupancy sensor or vacancy sensor switch installed.

1.30 SEISMIC REQUIREMENTS

A. Equipment and work shall meet the restraint requirements for the designated Seismic Design category. This shall include all installation and connections of material and equipment to the building structure. Refer to Structural Drawings for Seismic Design category and ASCE7 for electrical requirements.

1.31 PHASING, DEMOLITION AND MAINTAINING EXISTING SERVICES

A. During the execution of the work, required relocation, etc., of existing equipment and systems in the existing building areas where new work is to be installed or new connections are scheduled to be made, shall be performed by the Electrical Subcontractor, as required by job conditions and as determined by the Architect in the field, to facilitate the installation of the new system, while demolition, relocation work or new tie ins will be performed. Outages required for construction purposes shall be scheduled for the shortest practical period of time, in coordination with the Owner's designated representative, for specified, mutually agreeable periods of time, after each of which the interruption shall cease and the service shall be restored. This procedure shall be repeated to suit the Owner's working schedule, as many times as required until all work is completed. Any outages of service shall be approved by the Owner, prior to commencing the work. No outages or shutdowns of service shall occur without the written authorization of the Owner prior to commencing the work. Give notice of any scheduled shutdowns, a minimum of two (2) weeks in advance. Owner shall make their best efforts to meet this request without adversely affecting the electric service to the existing building.

B. Prior to any deactivation and relocation or demolition work, consult the Contract Drawings and arrange a conference with the Architect and Owner's Representative in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect all equipment designated to be relocated and reused or to remain in operation and be integrated with the new systems.

C. All deactivation, relocation and temporary tie-ins of electrical systems and equipment shall be provided by the Electrical Subcontractor. All demolition and removal of electrical systems and equipment designed to be demolished shall be provided by the Electrical Subcontractor. Place all demolished electrical materials except hazardous materials (PCB lighting ballasts, fluorescent lamps, etc.) as determined by the Authorities Having Jurisdiction in General Contractor's dumpster. All hazardous electrical materials shall be legally disposed of by the Electrical Subcontractor.

D. The Owner reserves the right to inspect the material scheduled for removal and salvage any

items he deems usable as spare parts.

E. Phasing:

1. The Electrical Subcontractor shall construct the subject project in phases as directed by the Architect to suit the project progress schedule, as well as the completion date of the project.

2. For additional information related to phasing, review the General Conditions and Supplementary Conditions and the Architectural Drawings.

PART 2 – PRODUCTS

2.1 GENERAL

A. Product Specifications are written in such a manner so as to specify what materials may be used in a particular location or application and therefore do not indicate what is not acceptable or suitable for a particular location or application. As an example: Non-metallic sheathed cable is not specified; therefore it is not acceptable.

B. For purpose of establishing a standard of quality and not for purposes of limiting completion, the basis of this Specification is upon specified models and types of equipment and materials, as manufactured by specified manufacturers.

C. In all cases, standard cataloged materials and systems have been selected. Materials such as lighting fixtures specially manufactured for this particular project, and not part of a manufacturer's standard product line, will not be acceptable. In the case of systems, the system components shall be from a single source regularly engaged in supplying such systems. A proposed system made up of a collection of various manufacturers products will be unacceptable.

D. Where Specifications list manufacturers names and/or "as approved" or "equal approved by Designer", other manufacturers equipment will be considered if equipment meets Specification requirements and has all features of the specified items as are considered essential by the Architect.

E. All materials shall be new and shall be UL listed.

2.2 ARC-FLASH HAZARD WARNING

A. In accordance with NFPA 110.16, all electrical equipment shall be provided with factory or field marking which will warn personnel of potential electric arc flash hazards.

2.3 RACEWAYS AND FITTINGS

A. Raceways – General:

1. No raceway shall be used smaller than 3/4" diameter. No conduit shall have more than three (3) 90° bends in any one run, and where necessary, pull boxes shall be provided.

2. Rigid metal conduit (RMC) conforming to, and installed in accordance with, Article 344 of NFPA 70 shall be heavy wall zinc coated steel conforming to American Standard Specifications C80-1 and may be used for service work, exterior work, slab work, and below grade level slab, wet locations, and in mechanical rooms and where raceway may be subjected to mechanical damage, i.e., loading docks, workshops, etc.

3. Intermediate metal conduit (IMC) conforming to, and installed in accordance with Article 342 of NFPA 70 shall be zinc coated steel and may be used in all areas similar to RMC.

4. Thin wall conduit (EMT), conforming to, and installed in accordance with, Article 358 of NFPA 70 shall be zinc coated steel, conforming to industry standards, may be used in masonry block walls, stud partitions, above furred ceilings where exposed but not subject to mechanical damage, and shall be used for fire alarm work.

5. Flexible metal conduit (FMC) conforming to, and installed in accordance with Article 348 of NFPA 70 shall be used for connections to recessed light fixtures, vibrating equipment and motors. All FMC shall be secured and supported in accordance with Article 348 of NFPA 70.

6. Liquidtight flexible metal conduit (LFMC) conforming to, and installed in accordance with Article 350 of NFPA 70 shall be used for connections to light fixtures, vibrating equipment and motors. All LFMC shall be secured and supported in accordance with Article 350 of NFPA 70. If used on roof applications, all LFMC shall be supported by sleepers approved by the Architect prior to installation.

7. Rigid non-metallic conduit may be used at the Contractor's option for underground electric and telephone services outside the foundation wall and shall be polyvinyl chloride (PVC) schedule 40 or 80, 90° C. If option of rigid non-metallic conduit is exercised, underground runs outside the foundation wall shall be concrete encased at Contractor's expense. Schedule 40/80 conduit shall be installed in conformance with Article 352 of NFPA 70. Use of type EB or A PVC conduit is not allowed.

8. PVC Schedule 40 may also be used for below grade slab circuits within building confines. Below slab rigid non-metallic conduits do not require concrete encasement. Rigid non-metallic conduits shall not be used in slabs. Rigid steel elbows or stubs shall be used for penetrations from below slab or through exterior walls into building. PVC shall not be installed within building. Raceways and fittings shall be produced by same manufacturer. All PVC conduit shall comply with ANSI/UL 651.

9. Acceptable Manufacturers:
    a. Wheatland Tube Company
    b. Allied Tube
    c. Western Tube & Conduit
    d. Carlon
    e. Perma-Cote Supreme
    f. Cantex

10. Fittings:
    a. Provide insulated bushings on all raceways that house conductors #4 AWG or larger at all threaded fittings no matter what the size of the conductor.
    b. Manufacturer's standard fittings shall be used for raceway supports.
    c. Expansion Fittings: Expansion fittings shall be used where structural and concrete expansion joints occur and shall include a ground strap.
    d. Couplings for rigid metal conduit and IMC shall be threaded type. Provide insulated bushings.
    e. All fittings for EMT conduit shall be steel. No die-cast fittings are allowed. Set screw and

compression connectors are allowed.

f. Threadless fittings for EMT shall be watertight compression type. All fittings shall be concrete tight.

g. Cable supports in vertical raceways shall be of the split wedge type. Armored cable supports for vertical runs to be of wire mesh basket design.

h. Wall entrance seals shall be equal to O.Z. Gedney type “WSK” or Link-Seal.

i. Couplings, elbows and other fittings used with rigid nonmetallic raceways shall be of the solvent cemented type to secure a waterproof installation.

j. Acceptable manufacturers:

1) O.Z. Gedney

2) Crouse Hinds

3) American Fittings

4) Hubbell

5) Thomas & Betts

2.4 WIRING MATERIALS

A. Building Wire and Cable shall be copper with 600V insulation, THWN for branch circuitry and XHHW for feeders.

B. Conductors shall be of soft drawn 98% minimum conductivity properly refined copper, solid construction where No. 10 AWG and smaller, stranded construction where No. 8 AWG and larger.

C. Exterior of wires shall bear repetitive markings along their entire length indicating conductor size, insulation type and voltage rating.

D. Exterior of wires shall be color coded, so as to indicate a clear differentiation between each phase and between each phase and neutral. In all cases, grounded neutral wires and cables shall be identified by the colors “white” or “gray”. In sizes and insulation types where factory applied colors are not available, wires and cables shall be color coded by the application of colored plastic tapes in overlapping turns at all terminal points, and in all boxes in which splices are made. Colored tape shall be applied for a distance of 6 inches along the wires and cables, or along their entire extensions beyond raceway ends, whichever is less.

E. Final connections to motors shall be made with 18” of neoprene sheathed flexible conduit.

F. Minimum branch circuit conductor size shall be No. 12 AWG installed in conduit. Motor control circuit wiring shall be minimum No. 14 AWG installed in conduit.

G. Fire alarm and security system wiring shall be per manufacturer’s recommendations.

H. Other wires and cables required for the various systems described elsewhere in this section of the Specifications shall be as specified herein, as shown on the Contract Drawings, or as recommended by the manufacturer of the specific equipment for which they are used, all installed in conduit.

I. Metal clad sheathed cable NFPA 70, type MC may be used for branch circuitry where run concealed, and not subject to physical damage. All type MC cable used shall contain a full size

insulated ground conductor. All conductors shall be copper. All type MC cable insulation used shall have voltage rating of 600 volts, shall have a temperature rating of 75° C, and shall be thermoplastic material. Armor material shall be steel and armor design shall be interlocked metal tape. Fire alarm rated MC cable may be used for fire alarm work where concealed and acceptable to the Local Authorities Having Jurisdiction.

J. Wiring materials shall be manufactured by Southwire, Prysmian, General Cable, or equal.

2.5 OUTLET, JUNCTION, PULL BOXES AND WIRING TROUGHS FOR ALL SYSTEMS

A. Outlets:

1. Each outlet in wiring or raceway systems shall be provided with an outlet box to suit conditions encountered. Boxes installed in normally wet locations shall be of cast-metal type having hubs. Concealed boxes shall be cadmium plated or zinc coated sheet metal type. Old work boxes with Madison clamps are not allowed in new construction.

2. Each box shall have sufficient volume to accommodate number of conductors in accordance with requirements of NFPA 70. Boxes shall not be less than 1-1/2” deep unless shallower boxes are required by structural conditions and are specifically approved by Architect. Ceiling and bracket outlet boxes shall not be less than 4” octagonal except that smaller boxes may be used where required by particular fixture to be installed. Flush or recessed fixtures shall be provided with separate junction boxes when required by fixture terminal temperature requirements. Switch and receptacle boxes shall be 4” square or of comparable volume.

3. Acceptable Manufacturers:

a. Appleton

b. Crouse Hinds

c. Steel City

d. RACO

B. Pull and Junction Boxes: Where necessary to terminate, tap off, or redirect multiple raceway runs or to facilitate conductor installation, furnish and install appropriately designed boxes. Boxes shall be fabricated from code gauge steel assembled with corrosion resistant machine screws. Box size shall be as required by Code. Where intermediate cable supports are necessary because of box dimensions, provide insulated removable core brackets to support conductors. Junction boxes are to be equipped with barriers to separate circuits. Where splices are to be made, boxes shall be large enough to provide ample work space. All conductors in boxes are to be clearly tagged to indicate characteristics. Boxes shall be supported independently of raceways. Junction boxes in moist or wet areas shall be galvanized type. Boxes larger than 4 inches square shall have hinged covers. Boxes larger than 12 inches in one dimension will be allowed to have screw fastened covers, if a hinged cover would not be capable of being opened a full 90 degrees due to installation location.

2.6 WIRING DEVICES

A. Provide wiring device type plates for all wall-mounted devices. All wall plates shall be smooth high impact nylon for all areas, color as directed by the Architect. Provide galvanized steel for all Utility, Electric and Mechanical Rooms.

B. Wiring devices standard for the project (i.e., with no specific type indicated) shall conform to the following:

1. Visible part colors of wiring devices shall be as directed by the Architect for all areas. Provide brown devices for all Utility, Electrical and Mechanical rooms.

2. Exclude compact or “despard” type devices.

C. Wiring device switches shall be toggle type, A.C. quiet design, specification grade, 20 amps on 120 volt circuits. Switches shall be mounted 48” to center line above finished floor unless noted otherwise.

1. Single pole switch shall be equal to Hubbell No. 1221.

2. Double pole switch shall be equal to Hubbell No. 1222.

3. Three-way switch shall be equal to Hubbell No. 1223.

4. Four-way switch shall be equal to Hubbell No. 1224.

5. Single pole pilot light switch shall be equal to Hubbell No. HBL 1221PL.

6. Equivalent 277 volt 20 amp switches shall be used where required.

D. Standard duplex convenience receptacles shall be 125 volt, 20 amps, three wire (two circuit wires plus ground), “U-bar” ground NEMA slot configuration 5-20R specification grade. Receptacles shall be mounted 18” to center line above finished floor unless noted otherwise.

1. Equal to Hubbell No. 5362.

2. Where indicated on plans provide receptacles with ground fault current interrupters, UL Class A; 20A, 125V to be equal to Hubbell No. GF5362. All GFI receptacles shall be self-testing type in compliance with UL 943.

3. Where indicated on plans, provide receptacles with integral USB charging ports; compliant with USB BC 1.2 rated 3A, 5VCD, 20A, 125V tamper resistant equal to Hubbell No. USB20X2W.

E. Non-standard convenience receptacles and special purpose power supply receptacles shall be as listed on plans.

F. Devices and device plates for flush wall devices which are not integrally equipped with same, shall be as directed by the Architect.

G. For unfinished spaces, plates for surface-mounted wall devices which are not integrally equipped with same, shall be galvanized sheet steel, formed raised type which does not overlap box. Where for switches, such plates shall have toggle guards.

H. Where more than one wiring device is indicated in the same location, the devices shall be mounted in gang under a common wall plate.

I. Mount duplex convenience and power receptacles vertically with grounding posts at top of device unless otherwise indicated. Locate grounding post to left when horizontal mounting is indicated.

J. Wiring devices and associated hardware shall be manufactured by Leviton, Hubbell or Pass and Seymour.

K. Floor Outlets (Poke-Thru Type):

1. Thru-floor assembly of floor outlets for power and communications shall be UL listed and have a two-hour fire rating. Core drilling shall be by Electrical Subcontractor.

2. Complete assembly shall consist of a flange assembly, slide holder assembly, and insert assembly.

3. Length of extension raceway shall be sufficient to penetrate bottom of slab. Coordinate ordering of raceway with type of slab.

4. Thru-floor assemblies shall be as manufactured by Raceway Components, Inc., or equal.

L. Dimmer Controls:

1. All devices shall be UL listed specifically for the required loads (i.e., incandescent, fluorescent, magnetic low voltage, electronic low voltage). Manufacturer shall provide file card upon request. Universal dimmers are not acceptable.

2. All dimmers and switches shall incorporate an air gap switch. The air gap switch shall be capable of meeting all applicable requirements of UL 20 for air gas switches in incandescent dimmers.

3. All dimmers and switches shall provide power failure memory. Should power be interrupted and subsequently returned, the lights will come back on to the same levels set prior to the power interruption. Restoration to some other default level is not acceptable.

4. Dimmers and switches shall meet ANSI/IEEE Std. C62.41-1980, tested to withstand voltage surges of up to 6000V and current surges of up to 200A without damage.

5. Dimmers and switches shall meet the UL 20 limited short circuit test requirement for snap switches.

6. Dimmer shall provide a smooth and continuous Square Law dimming curve.

7. Dimmers shall be voltage regulated so that + 10% variation in line voltage shall cause not more than +5% variation in load voltage when dimmer is operating at 40V (5% light output).

8. Dimmers shall be 2000 watt equal to Lutron Nova Series. Single pole dimmers shall be “slide to off” type. Three-way dimmers shall be “preset” type used with appropriate 3 or 4-way linear slide switches.

2.7 GROUNDING REQUIREMENTS

A. Ground all systems and equipment in accordance with best industry practice, the requirements of NFPA 70, Article 250 and the following:

1. The ground bus of the main switchboard shall be connected to the main grounding electrode specified below by means of insulated conductors run in conduit.

a. Metal underground water pipes.

b. Metal frame of building.

c. Concrete encased electrode.

d. Rod and pipe electrodes.

e. Ground ring.

2. Provide grounding bonds between all metallic conduits of the light and power system which enter and leave cable chambers or other non-metallic cable pulling and splicing boxes. Accomplish this by equipping the conduits with bushings of the grounding type individually cross connected.

3. Bond metallic conduits containing grounding electrode conductors and main bonding conductors to the ground bus service enclosure and/or grounding electrode at both ends of each run utilizing grounding bushings and jumpers.

4. Provide grounding bonds for all metallic conduits of the light and power system which terminate in pits below equipment for which a ground bus is specified. Accomplish this by equipping the conduits with bushings of the grounding type connected individually to the ground bus.

5. Provide supplementary ground bonding where metallic conduits terminate at metal clad equipment (or at the metal pull box of equipment) for which a ground bus is specified. Accomplish this be equipping the conduits with bushings of the grounding type connected individually by means of jumpers to the ground bus. Exclude the jumpers where directed. This exclusion will be required where an isolated ground for electronic equipment is to be maintained.

6. Each grounding type bushing shall have the maximum ground wire accommodation available in standard manufacture for the particular conduit size. Connection to bushing shall be with wire of this maximum size.

7. Bonding conductors on the load side of the service device and equipment grounding conductors shall be sized in relation to the fuses or trip size of the overcurrent device supplying the circuit.

8. The central equipment for the fire protective alarm system and telephone system shall have its grounding terminal connected to the grounding electrode by means of a No. 6 green coded insulated conductor, run in 3/4" conduit. Utilize a ground clamp of a type specifically manufactured for the purpose.

2.8 PHASING AND COLOR CODING

A. The insulation or covering of each wire or cable shall be color coded so as to provide for circuit identification as specified below:

120/208 V Circuits	Phase Circuits
Black	A
Red	B
Blue	C
White	Neutral
Green	Equipment Ground

B. Color coding shall be achieved by one of the following methods:

1. The insulation or covering shall be coded during manufacture by use of one of the following methods:

a. Colored compounds.

b. Colored coatings.

2. In sizes and insulation types where factory applied colors are not available, wires and cables shall be color coded by the application of colored plastic tapes in overlapping turns at all terminal points, and in all boxes in which splices are made.

C. The same colored cable shall be connected to the same phase throughout the project.

D. In general, building load centers and panelboards shall be phased “A”, “B”, “C”, left to right. The neutral, although it may be in different locations for different equipment, shall be identified.

2.9 SWITCHBOARD

A. The switchboard shall be of the free-standing deadfront, front accessible only, totally metal enclosed externally operable type, and shall consist of an assembly of standardized vertical sections, each having rigid frame construction of heavy gauge formed steel. Each section shall be thoroughly rustproof, primed and painted to provide an overall even appearance. Adjacent vertical sections shall be arranged for bolting together. Welded construction will be permitted only for individual vertical sections. Switchboards shall include all protective devices and equipment as listed on the Contract Drawings with the necessary interconnections, instrumentation and control wiring. All switchboard sections shall align on front and rear.

B. Its arrangement shall be such that their lowest current carrying parts are at least 12 inches above finished floor, and its height is no more than 90 inches.

C. It shall comply with all the latest applicable standards of NEC, NEMA, ANSI and UL, having all main overcurrent and switching devices individually mounted and front accessible only. All branch overcurrent and switching devices shall be panel mounted, and shall be front accessible only.

D. Molded Case Circuit Breakers:

1. Main and distribution feeder protective devices as shown shall be molded case air circuit breakers, built, tested and UL labeled per UL 489. Main and distribution feeder breakers shall have long time, short time, instantaneous, (LSI) trip functions. Main circuit breaker shall also have a ground fault (G) trip function.

2. Breaker trip unit shall be solid-state trip complete with built in current transformers, solid-state trip unit and flux transfer shunt trip. Breakers shall have interchangeable trip rating plugs with trip ratings as indicated on the Contract Drawings. Rating plugs shall be interlocked so they are not interchangeable between frames and interlocked such that breaker cannot be latched with rating plug removed. Provide test kit that is fully compatible with built-in test points for testing long delay and instantaneous functions of the breaker by means of a 120-volt operated test kit.

a. Solid-state instantaneous element shall be continuously adjustable from approximately 4 to 8 times the trip rating, with short time adjustment from instantaneous to 10 cycle delay for coordination purposes. Provide short delays over-ride feature providing for instantaneous tripping on high magnitude faults.

3. Molded case breakers shall have available interrupting current (AIC) rating shall meet or exceed the switchboard assembly UL listed integrated short circuit rating but shall have a minimum 65,000 symmetrical RMS interrupting capacity at 240 volts.

E. It shall have ample gutter space for outgoing cables.

F. It shall have complete bussing suitable for main service supply characteristics.

G. It shall have a neutral bus.

H. It shall have a ground bar sized per NEC but shall be minimum 2” x 1/4" copper bar run along the switchboard for its entire length. The ground bar shall be fastened and bonded to each vertical framing member of the switchboard.

I. Rear or side access to each vertical section shall not be required.

J. Switchboard bussing shall be of hard drawn 98% minimum conductivity copper and shall conform to the following:

1. No individual bar shall be of a thickness of more than 1/4 inch. Where necessary for current capacity, multiple parallel bars shall be used. Parallel bars shall be separated by copper spacers or washers maintaining a spacing equal to bar thickness.

2. Exclude divergent routing of electrically paralleled bars.

3. Connections shall be made up with cadmium plated steel bolts and nuts utilizing “Belleville” type washers or split locknuts plus flat washers.

4. The current density across bolted contact surfaces of bars shall not exceed 200 amps per square inch. Bolted contact surfaces of bars shall be silver or tin-plated.

5. Bracing and protective devices shall be such as to withstand and interrupt short circuit stresses of 65,000 amps symmetrical at 480 VAC minimum or available short circuit whichever is larger.

6. Bussing designated as mains shall be run for the full extend indicated without reduction in size.

7. Neutral bussing shall be full size.

8. Neutral bussing shall extend the same length as the main phase bussing with which it is associated.

9. The neutral bus shall be bonded to the ground bus by means of insulated copper cables.

10. Each neutral bus shall be properly drilled and tapped for each outgoing feeder requiring a neutral connection.

11. “Spaces only” for overcurrent protection and switching devices shall be bussed for the maximum device that can be fitted into them including all necessary hardware except the device itself.

12. Bussing and arrangement of overcurrent and switching devices shall be bussed for the maximum trip setting of the device that can be fitted into them.

K. Submit certification that the switchboard has withstood, without breakdown, a factory dielectric “Hi-Pot” test consisting of a one minute application of a 60 cycle AC test voltage applied between phase legs and from each phase leg to enclosure. The applied test voltage shall have an RMS valve of at least twice the line-to-line system voltage to which the switchboard is to be applied.

L. The main switchboard shall be listed with an Underwriters label attesting to its suitability as service entrance equipment.

M. Provide a separate barriered-off Utility Metering Compartment complete with hinged sealable door complying with Utility Company requirements. Bus work shall include provisions for mounting Utility Company current and potential transformers.

N. Provide a separate customer metering compartment with front hinged door and include the following:

1. Current transformers for each meter. Current transformers shall be wired to shorting type terminal blocks.

2. Potential transformers including primary and secondary fuses with disconnecting means for metering.

3. Microprocessor based metering system.

O. Provide small control wiring, necessary fuse blocks, suitable numbering strips and terminal blocks as required.

P. Provide adequate means for rigging, skidding and rolling.

Q. Switchboard shall be manufactured by Square D, Siemens, Eaton, or General Electric.

2.10 ENCLOSURES FOR INDIVIDUALLY MOUNTED OVERCURRENT AND SWITCHING DEVICES

A. Construction shall be NEMA Class I, where installed indoors.

B. Construction shall be NEMA Class IIIR, where installed outdoors, in mechanical rooms, in locations defined as damp or wet by NFPA 70 or where indicated as weatherproof.

C. Operating handles shall be front or side type to accommodate hand access space and flush or surface mounting requirements.

D. Each shall be equipped with padlock for locking operating handle in the open position.

2.11 PANELBOARDS

A. Panelboards shall consist of factory completed dead front assemblies of back pans, main busses, overcurrent and switching units, sheet metal cabinets and trims. They shall be so designed that switching and overcurrent devices can be replaced without disturbing adjacent units and without removing the main bus connectors, so that circuits may be changed without machine drilling or tapping.

B. Where indicated as power or distribution panels, they shall be as manufactured by Square D, Siemens, Eaton, or General Electric.

C. Bus bars for their mains shall be of copper having current capacities as indicated and sized for such capacities in accordance with Underwriter Laboratory standards. Provide double size neutral bus bars and lugs for all 120/208 volt panelboards where fed from “K” rated transformers. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height

without reduction.

D. A ground bus shall be provided for each panel. Each ground bus shall be of the same material as the phase and neutral buses.

E. Cabinets shall be fabricated from industry standard gauge galvanized sheet steel with corners lapped and riveted, or fastened by approved methods.

F. The inside and outside of the trims shall be factory painted with one (1) rust proofing primer coat and one (1) finish coat. The finish paint shall be of a type to which field applied paint will bond. All trims shall be hinged.

G. Cabinets and trims shall be suitable for the required mounting. Trims shall be fastened to cabinets and shall be of a type that is self-supporting on cabinets. Trims for flush panels shall overlap cabinets by at least 3/4" all around. Where two section panels are required, cabinets shall be of equal height including those cases where there is one main for both sections.

H. Cabinets and trims for lighting and appliance panels shall accommodate and conform to the following limited dimensions:

1. Minimum wiring gutter width on each side: 5-3/4”.

2. Maximum overall width: 24”.

3. Maximum overall depth: 6”.

I. Where wires or cables are used within panelboards to make up internal connections (factory installed or otherwise) such wire or cable shall have copper conductors only.

J. Any cabinet for a power or distribution panel shall (regardless of the actual devices required to be in it) have a width, depth and bussing adequate for a 3-pole branch device equal in rating to the panel mains. In no case shall the cabinet be wider than 42” or deeper than 18”.

K. Hinged doors covering all switching device handles shall be included in all panel trims.

L. Doors in panelboard trims shall conform to the following:

1. In making switching device handles accessible, doors shall not uncover any live parts.

2. Doors shall have flush type paracentric cylinder locks and catches. Two (2) keys shall be supplied for each lock and each key shall open all panelboards. Locks and keys shall conform to a “standard keying policy” as directed.

M. Where “spaces only” for overcurrent protection and switching devices are called for in a panel, its main bus, and backpan, as well as its cabinet and trim, shall be extended to accommodate these spaces and shall include all necessary hardware including bus connectors to add future devices.

N. Panelboards shall comply with the following industry standards:

1. UL Standards:

a. Panelboards – UL67.

b. Cabinet & Boxes – UL50.

2. NEMA Standard – PB1.

O. Panelboards shall be labeled with UL short-circuit rating adequate for the available short-circuit and based on the lowest panel mounted circuit breaker available UL listed interrupting current rating, but in no case less than 65 ka for 480 volt and 22 ka for 240 volt panelboards.

P. Provide “lock on” clips for the toggle handles of certain branches serving the Fire Alarm System, security, etc.

Q. Panelboards shall be manufactured by Eaton, Siemens, Square D, or General Electric.

2.12 MOLDED CASE CIRCUIT BREAKERS

A. Molded case type circuit breakers shall consist of manually operated quick-make quick-break mechanically trip free operating mechanisms for simultaneous operation of all poles, with contacts, arc interrupters and trip elements for each pole, all enclosed in molded phenolic plastic cases.

1. Their tripping units shall be of the “thermal magnetic” type having bimetallic elements for time delay overload protection and magnetic elements for short-circuit protection.

2. They shall be manually operable by means of toggle type operating handles having “tripped” position midway between the “on-off” positions.

3. They shall each be contained in an individual case enclosing only the number of poles required for the particular breaker.

4. All panels and individually mounted circuit breakers shall have short circuit ratings exceeding the available short-circuit of the values indicated in the “Power System Studies” in this section by a factor of 1.2 with a minimum as follows:

a. 240V class panels/breakers: 10 kAIC where shown fed by a 150 kVA or less transformer

1) 10 kAIC where shown

2) 22 kAIC where shown fed by a 300 kVA or less transformer.

b. 480V Class Panels/Breakers shall be 65 kAIC.

5. They shall be of the “bolted-in” type.

a. Where necessary, to accommodate other requirements, their frame sizes shall be increased to conform to such requirements, frame sizes being indicated only as a reference to the minimum acceptable interrupting ratings noted above.

b. Where single pole in trip sizes 20 amps or less, they shall be rated for switching duty.

c. They shall be equipped with 5 milliamp sensitivity ground fault interrupting features where so indicated.

d. All circuit breakers connected to lighting branch circuits shall be high magnetic type breakers.

6. They shall be manufactured by Square D, Siemens, Eaton, or General Electric.

2.13 CARTRIDGE FUSES

A. Cartridge fuses shall be as follows:

1. Provide a complete set of fuses for each item of fusible type equipment. Fusible equipment furnished by other Contractors will be complete with fuses.

2. Secondary system fuses, rated at 600 volts or less, shall be UL listed and constructed in conformance with the applicable standards set forth by NEMA and ANSI. All fuses of a particular class shall be of same manufacturer.

3. Regardless of actual fault current, they shall, at full recovery voltage, be capable of safely interrupting fault currents of 200,000 amperes RMS symmetrical or 340,000 amperes RMS asymmetrical, deliverable at the line side of the fuse.

4. Circuits 0-600 amperes shall be protected by the equal of Bussman “Low Peak” current limiting fuses, LPN-RK (250 volts), LPS-RK (600 volts), UL class RK-1.

5. Fuses shall be suitable for application to fuse gaps which reject other types of fusing.

6. Supply 10% spare fuses of each size and type 60 amps and less. Supply three (3) spare fuses for each size and type over 60 amps.

B. Cartridge fuses shall be manufactured by Bussman, Gould or EFCO.

2.14 LIGHTING FIXTURES

A. All lighting fixtures shall be in accordance with identifications on the Contract Drawings and the following:

1. Finishes shall be as selected by the Architect or as indicated on the plans.

2. Any additional appurtenances required for installation and operation, where same are not covered by the identification used on the Contract Drawings, shall be included.

3. Recessed fixtures shall be coordinated with ceiling construction.

4. Exact location of all fixtures shall be confirmed with Architect prior to rough-in.

5. Recessed fixtures throughout shall have their components, wiring and external connections coordinated for use in ceilings utilized as air handling plenums.

6. Fixtures for use outdoors or in areas designated as damp locations, shall be suitably gasketed and UL listed for such applications.

7. All fixtures shall be UL approved with labels attesting thereto.

8. The Contractor shall obtain all information relative to the exact type of hung ceilings and suspension systems to be installed before ordering any recessed fixtures. This Contractor shall furnish the proper type fixtures applicable to the ceiling framing system. If, other than the type of fixtures specified are required for installation, due to the type of ceiling construction, this Contractor shall furnish and install the proper type fixtures and mounting appurtenances required at no extra charge.

9. The Contractor shall coordinate the exact locations of all lighting fixtures with the ceiling pattern during the construction period and before installation of the fixtures. Interferences between lighting fixtures, and other equipment, shall be brought to the attention of the General Contractor.

10. Include the aiming and/or adjustments of all lighting fixtures requiring same in accordance with instructions issued by the Architect in the field.

11. All lamp sockets in lighting fixtures shall be suitable for the indicated lamps and shall be set so that the lamps are positioned in optically correct relation to all lighting fixture components.

12. Lighting fixtures shall be supported from building structure only, not from hung or suspended ceiling, by means of chains, threaded rods or #14 gauge tie wire.

13. All fixtures shall include seismic clips and shall be supported to comply with seismic regulations.

14. Lamps shall be manufactured by Eaton, Phillips. OSRAM, or Sylvania.

B. LED Lamps and Luminaires:

1. Solid State Lighting/Light Emitting Diode (LED) Lamps and Luminaries:

   a. Luminaire manufacturer shall have a minimum of five (5) years' experience in the manufacture and design of LED products and systems and no less than one hundred (100) North American installations.

   b. Unless otherwise specified, all LED luminaires and power/data supplies shall be provided by a single manufacturer to ensure compatibility.

   c. All components, peripheral devices and control software are to be provided by and shall be the responsibility of a single entity. All components shall perform successfully as a complete system.

   d. Include all components necessary for a complete installation. Provide all power supplies, synchronizers, data cables, and data terminators for a complete working system.

   e. All LED sources used in the LED luminaire shall be of proven quality from established and reputable LED manufacturers and shall have been fabricated after 2007.

2. Replacement and Spares:

   a. Manufacturer will keep record of original bin for each LED module and have replacement modules from the same bin available for three (3) years after date of installation.

   b. Manufacturer will keep an inventory of replacement parts (source assembly, power and control components).

   c. Manufacturer's LED system will not become obsolete for ten (10) years.

   d. Manufacturer will provide exact replacement parts, or provide upgraded parts that are designed to fit into the original luminaire and provide equivalent distribution and lumen output to the original, without any negative consequences.

   e. Manufacturer has in place a written recycling and re-use program, and will accept returned product and/or components for recycling or re-use.

   f. Manufacturer will properly dispose of non-recyclable components that are deemed harmful to the environment.

   g. System shall carry a full warranty for five (5) years. Manufacturer shall be responsible for cost of labor not to exceed $50 per individual part, and cost of shipping, to replace any component of the system that fails within two (2) years of installation.

3. Products and Components – Performance:

a. LED luminaires and components shall be UL listed or UL classified.

b. LED luminaires and components shall be CE certified.

c. LED luminaires and components shall be PSE marked.

d. All LED luminaires shall be subjected to the following JEDEC Reliability Tests for Lead-free Semiconductors: HTOL, RTOL, LTOL, PTMCL, TMSK, Mechanical Shock, Variable Vibration Frequency, SHR, Autoclave.

e. To ensure luminaire quality, luminaire shall have been tested under accelerated life test conditions including an operating temperature span of 360 degrees F, and cyclic loading up to 60G.

f. All products included in system shall use Mil-Std 810F, Random Vibration 7.698g as a minimum standard. In installations subject to vibration, luminaire shall be installed with vibration isolation hardware to sufficiently dampen vibrations.

g. All LED components shall be mercury and lead-free.

h. All manufacturing processes and materials shall conform to the requirements of the European Union's Restriction on the Use of Hazardous Substances in Electrical and Electronics Equipment (RoHS) Directive, 2002/95/EC.

i. LEDs shall comply with ANSI/NEMA/ANSLG C78.377-2008 – Specifications for the Chromaticity of Solid State Lighting Products. Color shall remain stable throughout the life of the lamp. Color shall match approved sample.

j. LEDs shall comply with IESNA LM-80 – Standards for Lumen Maintenance of LED Lighting Products.

k. White LEDs shall have a rated source life of 50,000 hours under normal operation conditions. RGB LEDs shall have a rated source life of 100,000 hours. LED "rated source life" is defined as the time when a minimum of 70% of initial lumen output remains.

l. Luminaire assembly shall include a method of dissipating heating so as to not degrade life of source, electronic equipment, or lenses. LED luminaire housing shall be designed to transfer head from the LED board to the outside environment. Luminaire housing shall have no negative impact on life of components.

m. Manufacturer shall supply in writing a range of permissible operating temperatures in which system will perform optimally.

n. High power LED luminaires shall be thermally protected using one or more of the following thermal management techniques: metal core board, gap pad, and/or internal monitoring firmware.

o. LEDs shall be adequately protected from moisture or dust in interior applications.

p. For wet and damp use, LED-based luminaires itself shall be sealed, rated, and tested for appropriate environmental conditions, not accomplished by using an additional housing or enclosure. Such protection shall have no negative impact on rated life of source or components, or if so, such reductions shall be explicitly brought to the attention of the Designer.

q. All hardwired connections to LED luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.

r. The LED luminaire shall be operated at constant and carefully regulated current levels. LEDs shall not be overdriven beyond their specified nominal voltage and current.

s. RGB LED luminaries shall utilize an equal combination of high brightness red, blue and

green LEDs, unless otherwise noted, to provide up to 16.78 million additive RGB colors and shall be capable of at least 8-bit control.

t. Manufacturer shall be able to provide supporting documentation of the product meeting third party regulatory compliance.

u. Manufacturer shall ensure that products undergo and successfully meet appropriate design and manufacturability testing including Design FMEA, Process FMEA, Environmental Engineering Considerations and Laboratory Tests, IEC standards and UL/CE testing.

v. All LED luminaires (100% of each lot) shall undergo a minimum twenty-four (24) hour burn-in during manufacturing, prior to shipping.

w. Manufacturer shall provide Luminaire Efficacy (lm/W), total luminous flux (lumens), luminous intensity (candelas) chromaticity coordinates, CCT and CRI optical performance, polar diagrams, and relevant luminance and illuminance photometric data. Provide data in IES file format in accordance with IES LM-79-2008, based on test results from an independent Nationally Recognized Testing Laboratory.

x. Power/Data supply shall have the following:

1) Supply outputs shall have current limiting protection.

2) Supply shall provide miswiring protection.

3) Supply shall have power factor correction.

4) Supply shall provide connections that are conduit-ready or clamp-style connections in the case of low-voltage wiring.

5) Supply shall come with a housing that meets a minimum IP20 rating for dry location installation unless located in a damp or wet location.

6) Supply shall be UL listed for Class 1 or Class 2 wiring.

2.15 TELEPHONE/DATA EMPTY RACEWAYS AND OUTLETS SYSTEM

A. The Electrical Contractor shall furnish and install, complete in every respect, a telephone empty raceway system, all interior raceways, pull boxes, plywood backboards, outlets, outlet cover plate, fittings, and all other appurtenances required, leaving the entire installation ready for installation of telephones, equipment and cables.

B. In general, the telephone system raceways, outlets and terminal backboard locations shall be as shown on the Contract Drawings.

C. All work and the entire installation of same shall be coordinated with the Architectural/ Engineering Coordination Office of the Telephone Company and the Electrical Contractor before the start of the construction and shall be in full conformance with their requirements and recommendations.

D. The Electrical Contractor shall furnish a nylon pull cord in each raceway to facilitate the pulling of cables in the future.

E. All outlet cover plates shall be furnished by the Electrical Contractor. All telephone outlet cover plates shall be blank cover plates of the same finish and by the manufacturer furnishing all other devices and switch plates installed throughout the buildings.

F. Telephone terminal locations are existing and shall be expanded as required as designed on the Contract Drawings. The Electrical Contractor shall furnish and install 3/4 inch thick sheet of

plywood backboard for the mounting of equipment and cable terminators by the Telephone Company. The backboards shall be painted with two (2) coats of fire-retardant paint by the Electrical Contractor. Exact dimensions of the backboards shall be as indicated on the Contract Drawings and as required by the Telephone Company.

G. Conduit from telephone outlets indicated on the Contract Drawings shall be installed into the nearest partition, extend a minimum of 6 inches into nearest accessible ceiling space and left ready to be used by the Telephone Company for the installation of their cables.

2.16 COMPUTER EMPTY RACEWAYS AND OUTLETS SYSTEM

A. The Electrical Subcontractor shall furnish and install computer outlets including conduit, outlet box, outlet cover plate, fittings, and all other appurtenances required, leaving the entire installation ready for installation of equipment under a separate Contract.

B. In general, computer outlets and empty conduit locations shall be as shown on the Contract Drawings.

C. The Electrical Subcontractor shall furnish a nylon pull cord in each conduit to facilitate the pulling of cables in the future.

D. All wall plates shall be furnished by the Electrical Contractor. All computer outlet cover plates shall be provided with a blank cover plate and be of the same finish and by the manufacturer furnishing all other device and switch plates installed throughout the renovation.

E. Conduit from computer outlets indicated on the Contract Drawings shall be installed into the nearest partition, extended a minimum of 6 inches into nearest accessible ceiling space and left ready to use for the installation of cables under a separate Contract.

2.17 FIRE ALARM SYSTEM

A. Scope:

1. Provide complete networked analog/addressable fire detection, evacuation alarm and control network in compliance with all specifications, drawings and applicable code requirements.

2. System shall be a networked microprocessor based fire alarm system which will integrate peripheral devices onto system via digital data communications.

3. Each initiating device shall have full analog detection capabilities; identify its' exact location, and shall operate as described elsewhere in these specifications.

4. Work in this section, as shown or specified, shall be in accordance with related Contract Documents.

5. Provide automatic and manual, closed circuit, multiplex fire alarm communications according to Contract Documents, wired, connected and left in first class operating condition.

6. Final connections, testing, and adjusting of system shall be done under direct supervision of system supplier.

a. System design and installation shall conform to following standards:

1) Equipment shall be UL listed for its intended purpose, including UL 864 (UOJZ, UOXX, UOQY and UUKL), 1480 and 1971.

b. NFPA standards 70, 72, 90A, 92A, and 101.

c. Current State Building, Electrical and Life Safety Codes.

d. Americans with Disabilities Act (ADA).

e. Requirements of local Authorities Having Jurisdiction, including permitting and acceptance procedures.

7. Shop Drawings shall include:

a. Complete point-to-point riser diagram showing all equipment and size, type and number of conductors and devices.

b. Large scale drawings of control panels, annunciators, transponders, showing module placement and spare capacity allowances.

c. Complete, itemized bill of materials with quantities, descriptions.

d. Original catalog data sheets to assure compliance with these specifications. This equipment shall be subject to approval, and no equipment shall be ordered without prior approval.

e. Calculations to support size of standby batteries, notification appliance circuits (NAC) and audio amplifiers submitted. Circuit calculations shall demonstrate proper current draw, voltage drop, wire size considerations and spare capacity allowances. Calculations shall be based on UL nameplate RMS voltage ratings. NAC calculations shall demonstrate 25 percent spare capacity.

f. Copy of Original Equipment Manufacturer's Warranty Statement.

g. Complete description of system Sequence of Operation.

h. Details of any special installation procedures.

i. Complete floor plans showing network nodes and all device locations and corresponding addresses. Point identification lists shall be included to ensure proper coordination of alarm messages and shall include each device type address number and corresponding CCO text message.

j. Confirmation that equipment supplier will provide on-site project management and supervision during system installation, and perform system testing and instruction.

k. Operation and maintenance manuals.

8. Conform to UL and NFPA standards for testing of completed installation by UL approved testing company.

9. O & M Manuals shall include the following:

a. All information submitted in final reviewed shop drawings.

b. As-built documentation which incorporates all modifications to completed system, whether made as field change or by change order.

c. Include copy of final test report, Record of Completion, as-built documentation and Fire Alarm Support Contracts as described herein.

B. Sequence of Operation:

1. Operation of manual station or activation of any automatic alarm initiating device (system smoke, system heat detector, waterflow) shall initiate system-wide but only in respective building/wing, response according to established response procedures and as follows:

a. Initiate transmission of alarm to Municipal Fire Station via [on board dialer/DACT] [Master Box]. Include the cost for monitoring at a UL listed central station for a period of one year.

b. Sound approved temporal code 3 horn signal over all audio circuits throughout entire building.

c. Upon any alarm condition, visual signals shall activate throughout the building. Visual notification shall be synchronized in accordance with applicable code requirements and latest NFPA 72 guidelines.

d. Flash an alarm LED and sound an audible signal at each FACP and the Fire Command Location. Upon Acknowledgment, the alarm LED shall light steadily and the audible shall silence. Subsequent alarms shall re-initiate this sequence.

e. Visually indicate alarm initiating device type and location via LCD display at all Fire Command Centers.

f. Operate prioritized outputs to release magnetically held smoke doors and magnetically locked doors throughout building.

g. Activate exterior W/P beacon.

h. Store system events in event history file.

i. Provide control signal to Lighting Control System to bring all lighting to full brightness.

2. Operation of any tamper switch, charging of pre-action system, or activation of other device designated to initiate system Supervisory condition shall cause the following to occur:

a. Flash Supervisory LED and sound audible tone at FACP and each network panel. Upon Acknowledgment, LED shall light steadily and audible shall silence. Subsequent Supervisory conditions shall re-initiate this sequence.

b. Visually indicate device type and location via LCD display located at FACP and remote annunciators.

c. Visually annunciate type of initiating device and its zone, floor or area as required on system annunciators. In addition, Supervisory LED and audible tone will sound. Upon Acknowledgment, LED shall light steadily and audible shall silence. Subsequent Supervisory conditions shall re-initiate this sequence.

d. Record event in event history log. Restorations shall likewise be recorded.

3. In event of System Trouble condition such as device removed, loss of AC Power or wiring fault, system Trouble condition shall occur as follows:

a. Flash Trouble LED and sound audible tone at FACP and each network panel. Upon Acknowledgment, LED shall light steadily and the audible shall silence. Subsequent Trouble conditions shall re-initiate this sequence.

b. Initiate reporting of event to designated staff members via email notification as required and described herein.

c. Visually indicate device type and location via LCD display located at FACP and network annunciator panel.

d. Visually annunciate type of initiating device and its zone, floor or area as required on all system annunciators. In addition, Trouble LED and audible tone shall sound. Upon Acknowledgment, LED shall light steadily and audible shall silence. Subsequent Trouble conditions shall re-initiate this sequence.

e. Record event in event history log. Restorations shall likewise be recorded.

C. General Requirements:

1. Fire alarm system shall be designed and UL and FM approved for Fire, Audio Evacuation and Security applications. System operational characteristics shall be stored in non-volatile EEPROM memory, shall be field programmable and capable of being edited with no factory involvement.

2. System shall support analog sensing techniques to monitor individual devices which enables user to set sensitivity parameters. Inputs shall be subject to multi-level alarm verification. System shall be capable of reporting status and sensitivity of each device and vectoring this information to printer. System shall automatically identify any detector which becomes dirty (maintenance alert), prior to false alarming.

3. System shall be supported by standby batteries. In event of loss of primary power, batteries shall support 24 hours of full supervisory operation followed by 5 minutes of alarm.

4. System shall be capable of nine levels of alarm prioritization, and allow control by event, and may include cross zoning, stepping, and/or logic statement inputs.

5. Equipment shall be new and unused. Components and systems shall be designed for uninterrupted duty. Equipment, materials and accessories covered by these requirements shall be provided by single manufacturer, or if provided by different manufacturers, recognized as compatible by both manufacturers.

6. Control equipment shall have transient protection devices to comply with UL 864 requirements.

   a. Isolated Loop Circuit Protector (ILCP): Provide isolated loop circuit protection device on all fire alarm circuits which extend beyond building by either aerial, underground or other methods (walkways, bridges or other above ground connectors).

   b. ILCP shall be located as close as practical to point at which circuits leave or enter building. Grounding conductor shall be No. 12 AWG wire having maximum length of 28 feet and connected to unified ground per NEC.

7. Circuiting Guidelines. Each initiating device and indicating circuit shall be electronically supervised and individually addressable. Wiring shall match existing conventions as follows:

   a. Individual Zone Addressable Modules shall be used to supervise and monitor waterflow, tamper, and status conditions from any related systems or devices.

   b. Zone Addressable Control Modules and/or programmable relays shall provide auxiliary control functions.

   c. Addressable loop wiring shall support all devices shown and allow for minimum of 25 percent spare capacity, and be wired in Class A, Style 7 fashion, with circuit isolation by floor and every 18 devices.

   d. Entire system shall allow minimum of 25 percent spare capacity. This shall apply to all aspects of system including CPU, cabinets, power supplies, amplifiers and batteries.

   e. Conventional Visual Appliance Circuits shall operate devices shown plus 25 percent spare capacity, and be wired in a Class A, Style Z fashion.

D. Fire Alarm Control Panel:

1. Provide a Fire Alarm Control System. System shall consist of the required Fire Alarm control and remote nodes, each sized to support a minimum of 1000 analog points, expandable to

2500 points. Panels shall be provided with programmable soft switches and associated LED's for panel silence, alarm silence, system reset and drill. Provide lamp test button. Provide individual LED's for power-on, common alarm, supervisory, fault. Adjacent to the fire control panel, provide passive graphic map depicting architectural layout of building with stairwells, elevators, major corridors and egress points shown.

2. Provide each panel with integral power supplies, amplifiers, addressable loop interface cards and standby batteries sized to serve building and/or space as shown. Panel shall have following functions:
   a. Monitor all initiating devices, report event to fire alarm network, annunciate alarmed device and its' location, capture elevators, conduct smoke control functions, and initiate audio/visual evacuation signaling and control sequences as described herein.
   b. Conduct municipal and off-site notification from main network panel as described herein.
   c. Initiating devices shall respond with their condition. Control relays shall be individually addressable by system to respond automatically in event of an alarm of related sensors. Manual override of control sequences and status feedback points shall be individually addressable.

3. Operator Controls: The control panel shall include an operator interface module consisting of 180 character backlit LCD display to display system wide alarm, trouble and supervisory conditions. Provide full system control from Fire Command Center, as well as control switches for status message scrolling, event acknowledgment, System Reset, and Alarm Silence. Display shall have LED's to indicate Power On, Fire Alarm, Supervisory, Trouble and Alarm Silenced status.

4. Addressable Loop Interface: Provide addressable loop interface card for each floor in each building. Each interface card shall be integral to network panel and support digital communications. Each circuit shall support a total circuit capacity of up to 250 analog/addressable detectors and wiring of twisted unshielded pair with distances of up to 12,500 feet.

5. Auxiliary Control / Annunciation: Provide required auxiliary switch and LED modules for discreet LED annunciation, zone disconnect, HVAC override, or related monitoring and control functions integral to each FACP. As a minimum, provide a minimum of 64 Auxiliary Override and Audio Control switches with status LED's and 8 HOA switches with corresponding status inputs and LED indicators for auxiliary functions, or as required. These are intended for use by Fire Department during events, or by authorized personnel during testing periods. Keypad entered commands for these functions shall not be acceptable

6. Field Power Supplies: Provide Field power supplies with 24VDC operating and NAC Circuits for Visual signals, 6 amps minimum. Each power supply module shall have 4 dedicated Class “A” NAC outputs rated at 3 amps each and charging circuit that will support up to 12AH batteries. Provide necessary interface to synchronize all power supplies together and provide each power supply with independent monitor module for trouble supervision. Field Power Supplies shall be located on Floor/Section which they serve.

7. Provide hard copy printout of system program to be maintained on site.

E. Remote LCD Annunciator.

1. Each annunciator shall contain a supervised; back lit, liquid crystal with a minimum of 8 lines with 21 characters per line. Where required, the annunciator shall include additional zonal annunciation and manual control without additional enclosures. The annunciator shall

support full ability to serve as the operating interface to the system and shall include the following features; Matched appearance with other system displays

F. Intelligent System Devices:

1. Provide intelligent analog addressable devices where shown and required. Analog devices shall utilize dual multi-color red/ green LED indicator which shall flash green to denote normal active communication and light red steadily to denote alarm condition. Devices shall be interchangeable with twist-lock bases that support discreet address-setting rotary decade switches. Each base shall support remote LED output, fault isolation circuitry, auxiliary relay contact, or sounder base with integral Piezo horn were such functions are required. Provide wire guards or other physical protection devices as shown on Contract Documents.

2. Provide analog/addressable combination photoelectric smoke and carbon monoxide (CO) detectors at the locations shown on the Contract Drawings. The combination smoke and CO detector shall provide two independent signals (smoke & CO) to the control panel for programming system responses. When mounted in a sounder base, the detector shall be capable of initiating a temporal 3-3-3 when smoke is detected or temporal 4-4-4-4 when CO is detected. Detectors that transmit a common signal to the control panel for both smoke and CO alarms shall not be considered as equals. The detector shall be listed under standards UL-268 and UL-2075.Each smoke detector shall be individually programmable to operate at any one of five (5) sensitivity settings. The detector shall also store pre-alarm and alternate pre-alarm sensitivity settings. Pre alarm sensitivity values shall be configurable in 5% increments of the alarm and alternate alarm sensitivity settings respectively. The detector shall be able to differentiate between a long term drift above the pre alarm threshold and fast rise above the threshold. The detector shall monitor the sensitivity of the smoke sensor. If the sensitivity shifts outside the UL limits, a trouble signal shall be sent to the panel. It shall be possible to automatically change the sensitivity of individual intelligent addressable smoke detectors for day and night (alternate) periods. Each detector shall utilize an environmental compensation algorithm that shall automatically adjust for background environmental conditions such as dust, temperature, and pressure. The detector shall provide a maintenance alert signal when 80% (dirty) of the available compensation range has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used. The smoke chamber shall be UL listed for field replacement. The electro-chemical CO sensor shall generate a CO alarm in compliance with UL-2034 requirements. The sensor shall have a nominal six-year life. When the sensor approaches the end of its useful life, it shall transmit a maintenance condition to the control panel, indicating the CO sensor board replacement is required. Only when the sensor is no longer operational shall a trouble condition be sent to the control panel. Sensors that transmit a common trouble indication for both sensor end-of-life and other causes of detector trouble shall not be considered as equal. Performing a “sensitivity” check from the panel shall report the approximate number months of CO sensor life remaining. Placing the CO detector in test mode shall facilitate the use of direct injection of small quantities of CO to check detector functionality. The CO sensor board shall be UL listed as field replaceable. Replacement of the CO sensor shall not require any field calibration.

3. Photoelectric Smoke Detector: Provide analog addressable photoelectric smoke detectors with adjustable sensitivity range from 0.2 to 3.7 percent obscuration where shown and required. Detectors shall provide complete analog features including alarm verification, environmental compensation, and multi-stage operation, were required.

4. Analog Heat Detectors: Provide Analog Heat Detectors. Analog heat detectors shall be field selectable for fixed temperature rating of 135 or 190 degrees, rate of rise operation of 15 degrees/minute, and will also include a low temperature warning (Supervisory condition) when ambient temperature reaches 40 degrees F. Where otherwise required, provide

conventional fixed temperature, weatherproof or explosion proof heat detectors in lieu of analog heat detectors. Conventional device shall be individually addressable via intelligent addressable module which shall be installed in heated, ventilated location.

5. Analog Duct Smoke Detector: Provide analog photoelectric duct-mounted smoke detectors mounted in air ducts where shown and required. Duct detectors shall be programmed for alarm event sequencing or required by AHJ. Each detector shall be supplied with duct-mount housing, remote indicator/test station and sampling tubes sized according to duct width. Provide necessary auxiliary relay outputs via addressable relay control modules with each detector in order to ensure required HVAC control, override and status reporting functions.

6. Intelligent Manual Pull Stations: Provide intelligent addressable manual stations where shown. Station shall be double action with screw terminals, toggle switch, and integral addressable electronics w status LED. Station shall be constructed of red Lexan with white raised letters and key reset switch. Station shall be keyed alike to FACP. Where ambient conditions preclude use of addressable devices, conventional weatherproof pull stations shall be used. Each conventional device shall be individually addressable via intelligent addressable module which shall be installed in heated, ventilated location.

    a. Provide tamperproof clear Lexan covers with red frame and spacer, and audible trouble alarm, Stopper II or equal where shown.

7. Monitor Module: Provide Zone Addressable input Modules to enable monitoring and supervision of related systems and devices via SLC addressable loop.

8. Relay Module: Provide Addressable Relay to provide supervised control of auxiliary circuits (AHU's, door holders, etc.) via SLC addressable loop. Relay shall provide supervised output rated for 3 amps @ 30VDC or .5 amps at 120VAC. Where current exceeds limitations, provide isolation relay (PAM-1 or equal) rated for required load.

9. Isolation Modules: Where additional circuit isolation is required beyond isolation of the addressable loop interface, provide field-mounted Isolator Modules every 20 devices to protect circuit integrity in event of a wiring fault and ensure Style 6 wiring conventions.

10. Drill Switch: Provide a two position keyed Drill switch with addressable monitor module located as shown on contract drawings. Switch shall be fully programmable to initiate a drill of programmed areas with-out transmitting Municipal Signal. Restoration of key switch to “normal” shall return FACP and associated control equipment to normal with no other user interface to system.

G. Notification Appliances:

1. Provide flush mounted combination Audio/Visual signaling appliances. Stand-alone devices may be used to augment combination units when necessary. Provide surface mount back boxes and alternate outdoor-rated appliances where ambient conditions dictate. Provide wire guards or other physical protection devices as shown on Contract Documents.

2. Provide synchronized xenon strobes in compliance with NFPA 72, and rated per UL 1971 testing criteria. Strobes shall have effective intensity field selectable by installer in the range of 15CD to 115 CD.

3. Provide audible detector mounting bases suitable for mounting on a 1-gang, 3½ or 4 inch octagon box and 4 inch square box at the locations shown on the Contract Drawings. The bases shall utilize a twist-lock design and provide screw terminals for all field wiring connections. Removal of the respective detector shall not affect communications with other

detectors. The audible base shall support all detector types and shall be capable of single or group operation. The audible base shall emit a temporal 3-3-3 fire alarm tone when smoke or heat has been detected. The audible base shall emit a temporal 4-4-4-4 CO alarm tone when CO has been detected. The outputs shall be configurable for low or high output by moving a reversible jumper. The system shall be UL2017 listed for dual signaling for this purpose. The audible bases shall provide a UL-268 reverberant room sound output of 90.8 dBA at 10ft (3m) for temporal 3-3-3 fire alarm and 84.1 dBA at 10 ft.(3m) for temporal 4-4-4-4 CO alarm.

H. System Accessories:

1. Municipal Connection: Provide one (1) telephone dialer/digital Communicator unit for off-site transmission of supervisory signals. Provide the cost for monitoring at a UL listed central station for a period of one year.

2. Sprinkler System Devices: Coordinate following to ensure that required installation and wiring of waterflow and tamper switches is accomplished in manner that will result in complete operable and tested sprinkler system. Each device shall be monitored as separate and distinct point.

   a. Waterflow shall activate alarm sequence.

   b. Tamper switches shall activate supervisory condition.

3. Pre-action Sprinkler Monitor and Releasing: If required, Fire Alarm System Supplier shall provide Pre-action Sprinkler System Releasing Control Panel integrated with Fire Alarm System Network. Related wiring shall be performed under this Section with Sprinkler System and devices installed by Fire Protection Contractor. FA supplier shall be responsible for coordinating all related trades to ensure complete code compliant monitoring.

4. Terminal Cabinets: Provide fire alarm terminal cabinets where necessary. Cabinets shall have removable hinged cover with key lock and red finish and are intended to house analog/addressable modules and facilitate filed wiring junctions.

5. Remote Alarm Indicators: Provide remote LED indicators for sensors located behind locked doors. Provide permanent label on each indicator identifying device type and actual location.

6. Exterior Strobe: Provide a flashing weatherproof strobe with minimum 150,000 candlepower output where shown. Strobe shall be properly installed on a weatherproof back box.

7. Auxiliary Power Supplies: Provide distributed network power supplies as required. Power supplies shall communicate directly to main Fire Alarm System via SLC communications to support network-based synchronization, and supervision of each panel for ground fault, loss of AC power and Battery Failure. Each notification circuit served shall be individually supervised via on-board circuitry.

8. Door Holders: Install flush, surface or floor-mounted 24VDC magnetic door holders where shown and required. Door holders will not be required to operate under standby power, following 30 second delay upon loss of primary AC power.

9. Key Repository: Provide Knox Box or approved equal key repository where shown and in accordance with local requirements.

I. Installation:

1. Installation shall be supervised and tested by system supplier. Work shall be performed by

skilled technicians under direction of experienced engineers, all of whom are properly trained and qualified.

J. Wiring:

1. Wiring for system shall be in accordance with Articles 760, 725, and 800 of National Electrical Code and local electrical codes. Cable shall be installed in conduit in accordance with manufacturer's instructions, with outgoing and return loops physically separated in accordance with applicable codes.

2. Provide complete wiring and conduit between all equipment. Devices shall be mounted upon and splices made in UL listed boxes. Wiring splices and transposing or changing of colors will not be permitted.

3. Junction boxes shall be painted red and labeled as 'Fire Alarm System' with decal or approved markings.

4. Fire Alarm control systems and equipment shall be connected to separate dedicated branch circuits, sized as required for proper service. Circuits shall be labeled 'FIRE ALARM'.

K. Final Tests, Records and Warranty:

1. Perform complete final test indicating proper functioning of system in accordance with all applicable codes and standards. Furnish copies of completed test report, as-built documentation and Record of Completion in accordance with NFPA 72 guideline to Owner and Architect for record purposes.

2. System test shall be conducted by UL certified testing company in accordance with UL guidelines and NFPA standards. Each and every device shall be tested in accordance with Manufacturer's recommendations.

3. Provide final test report and Record of Completion indicating proper functioning of the system and conformance to specifications. Test and Certificate of Completion shall be performed by factory-trained qualified technicians employed by Testing Contractor. Each and every device shall be tested, and standalone operation of remote panels shall be verified.

4. Final testing, certification and documentation shall be performed by same company that shall hold and execute Test and Inspection Contract.

5. In addition to pre-acceptance test, provide for complete and final Fire Department Acceptance Testing in accordance with requirements of Authorities Having Jurisdiction and applicable codes.

6. Provide a 3 year warranty from date of final acceptance on all equipment. Labor on installation shall be guaranteed for a period of 1 year. Provide warranty documentation in the submittal.

7. Guarantee all raceways and wiring to be free from inherent mechanical or electrical defects for one year from the date of final acceptance of system.

L. Annual Testing and Support Contracts:

1. Include as part of base bid cost of Test and Inspection contract which will be in effect for 1 Year.

2. Contract shall allow for quarterly tests according to UL, NFPA and local requirements. In addition to required testing and inspections, contract shall include cleaning and sensitivity test of each system detector following first year.

3. Upon expiration of warranty period and initial test and inspection contract, contract shall be renewable upon its expiration at discretion of Building Owner.

M. Training:

1. Provide services of manufacturer's representative-for an unlimited period, during normal business hours, to instruct owner's designated personnel and fire department response teams on operation of system.

N. Spare Equipment:

1. Provide system spare devices as follows:
   a. Manual stations - quantity of 3.
   b. System smoke detectors with bases - quantity of 5.
   c. System heat detectors with bases- quantity of 2.
   d. Speaker Strobe Units - quantity of 4.
   e. Strobe only units - quantity of 2.
   f. Duct smoke detector head and housing - quantity of 2.
   g. Addressable contact monitor modules - quantity of 2.
   h. Addressable relay modules - quantity of 2.

2.18 SURGE PROTECTIVE DEVICES (SPD'S)

A. Summary: Section Includes: Provide surge protective devices (SPD) integral to main switchboard for the protection of building electrical system.

B. References:

1. ANSI/IEEE C.62.41 and C62.45

2. UL 1449 – 3rd Edition

3. UL 1283

4. NEC – NFPA 70

5. NEMA LS1

6. NFPA

7. OSHA

8. IEEE Std. 1100

C. Submittals:

1. Shop Drawings: Provide Shop Drawings with wiring diagrams, installation information, testing and maintenance procedures, and operational information for the transient protection system. Shop Drawings shall be submitted to Engineer for approval before starting actual fabrication.

2. Submittal for Approval: Provide the following transient protection submittals:
   a. Dimensional Drawing of each SPD type, indicating proposed mounting arrangements.
   b. Written functional description of the transient protection circuit in terms of components, configuration, design approach, and performance capability per latest NEMA LS1.
   c. The means of connection of the SPD to the electrical distribution system per latest NEMA LS1.
   d. Manufacturer will provide UL-1449, Third Edition data card showing the Suppressed Voltage Rating (SVR) for the specific catalog number submitted. “Typical” UL 1449, Second Edition data is not acceptable.
   e. Per the requirements of NEC Article 285.6, the devices shall be marked with the short circuit current rating. This rating shall meet or exceed the available fault current. Test data from an independent testing laboratory shall be provided to demonstrate the short circuit current rating has been tested on a complete device.
   f. Submit test report data clearly demonstrating the maximum surge current rating has been tested on a COMPLETE SPD unit including all necessary fusing/overcurrent protection, thermal disconnects, integral disconnects and monitoring systems. Manufacturers who cannot provide this data will not be considered.
   g. Submit data demonstrating the complete SPD unit, including all overcurrent protection, is fully capable of a minimum repetitive surge current rating of 15,000 ANSI/IEEE C62.41, Category C3 (10kA) impulses without failure or a change in performance characteristics of more than 10%.
   h. Written detailed response to each paragraph of the specification indicating that the proposed product meets or exceeds this specification. If specific paragraphs are not met, provide written explanation as to why not.

D. Warranty: Description: Manufacturer shall provide a product warranty for a period of not less than 10 years from date of installation. Warranty shall cover unlimited replacement of system protection modules during warranty period. The first five years of this warranty will include any field labor required to perform repair or replacement work.

E. Manufacturers:

1. Acceptable Manufacturers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:
   a. Eaton
   b. Siemens
   c. Square D
   d. General Electric

2. Quality: The manufacturer shall be ISO 9001 certified, demonstrating world-class quality systems for the design and manufacture of the SPD units.

F. Environmental:

1. General Requirements:
   a. No audible noise shall be generated.
   b. No appreciable magnetic fields shall be generated. System shall be capable of use directly in computer rooms in any location without danger to disc units, disk packs, or tapes.
   c. Operating conditions:
      1) 30 – 130 Degrees F.
      2) 15 – 85 Percent Humidity Non-Condensing.

G. Surge Suppressors:

1. General Requirements:
   a. Rated for a 208Y/120 volt, 60 Hertz, 3 phase, 4 wire switchboard.
   b. Surge suppressors shall be in accordance with the following requirements:
   c. Unit shall be parallel in design and connect in parallel to main switchboard. Each surge suppression element (MOV) shall be individually fused so that a failure of one element and/or fuse shall not affect other surge suppression elements.
   d. Units shall be UL 1449, 2nd Edition Listed.
   e. Unit shall provide maximum UL 1449 3rd Edition Suppressed Voltage Rating (SVR) for 120, 120/208, or 120/240 volt system as follows:
      1) L-N = 330V.
      2) L-G = 400V.
      3) N-G = 400V.
      4) L-L = 600V.
   f. Units shall provide maximum UL 1449 3rd Edition Suppressed Voltage Rating (SVR) for 240, 277, or 277/480 Volt systems as follows:
      1) L-N = 700V.
      2) L-G = 800V.
      3) N-G = 600V.
      4) L-L = 1200V.
   g. Unit shall provide maximum surge current rating of 200,000 amperes L-N based on ANSI/IEEE C62.41 standard 8 by 20 microsecond current waveform.
   h. Unit shall have a short circuit current rating, which equals or exceeds that of the Main Switchboard.
   i. Unit shall be UL 1283 listed as an electromagnetic interference filter and provide 50 Ohm noise attenuation of at least 40 dB at 100 kHz, 30 dB at 1 MHz, 35 dB at 10 MHz, and 50 dB at 100 MHz.
   j. Unit shall include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status and operational integrity of each phase of the unit.
   k. Unit shall have a Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of SPD status.
   l. Unit shall include a built-in, push-to-test feature that tests the integrity of all modules,

MOV's and fuses in the system.

m. An adjustable (re-settable) counter shall be provided to totalize transient voltage surges in both the normal and common mode. The readout shall be at least a seven-digit LCD located on the unit front cover and provided with a 10-year battery backup to maintain counts in the event of power loss.

H. Grounding: Suppressor ground shall be bonded to the equipment grounding conductor and service entrance ground.

2.19 BRANCH PANEL SPD PROTECTION

A. Provide surge protective devices for branch circuit panelboards as shown in Schedule in this Section or on the Contract Drawings.

B. Provide surge protective devices for all panelboards designated as emergency in compliance with NEC Article 700.

C. References:

1. ANSI/IEEE C62.41 and C62.45.

2. UL 1449 – 3rd Edition.

3. UL 1283.

4. NEC – NFPA 70.

5. NEMA LS1.

6. NFPA.

7. OSHA.

8. IEEE Std. 1100.

D. Submittals:

1. Shop Drawings: Provide Shop Drawings with wiring diagrams, installation information, testing and maintenance procedures, and operational information for the transient protection system. Shop Drawings shall be submitted to Engineer for approval before starting actual fabrication.

2. Submittal for Approval: Provide the following transient protection submittals:

a. Dimensional Drawings of each SPD type, indicating proposed mounting arrangements.

b. Written functional description of the transient protection circuit in terms of components, configuration, design approach, and performance capability per latest NEMA LS1.

c. The means of connection of the SPD to the electrical distribution system per latest NEMA LS1.

d. Manufacturer will provide UL-1449, Third Edition data card showing the Suppressed Voltage Rating (SVR) for the specific catalog number submitted. "Typical" UL 1449, Second Edition data is not acceptable.

e. Per the requirements of NEC Article 285.6, the devices shall be marked with the short circuit current rating. This rating shall meet or exceed the available fault current. Test data from an independent testing laboratory shall be provided to demonstrate the short circuit current rating has been tested on a complete device.

f. Submit test report data clearly demonstrating the maximum surge current rating has been tested on a COMPLETE SPD unit, including all necessary fusing/overcurrent protection, thermal disconnects, integral disconnects and monitoring systems. Manufacturers who cannot provide this data will not be considered.

g. Submit data demonstrating the complete unit, including all overcurrent protection, is capable of a minimum repetitive surge current rating of 8,000 ANSI/IEEE C62.41, Category C3 (10kA) impulses without failure or performance degradation of more than 10%.

h. Written detailed response to each paragraph of the specification indicating that the proposed product meets or exceeds this specification. If specific paragraphs are not met, provide written explanation as to why not.

E. Warranty:

1. Description: Manufacturer shall provide a product warranty for a period of not less than 5 years from date of installation.

F. Manufacturers:

1. Acceptable Manufacturers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows:

a. Liebert

b. Current Technology

2. Quality: The manufacturer shall be ISO 9001 certified, demonstrating world-class quality systems for the design and manufacture of the SPD units.

G. Environmental:

1. General Requirements:

a. No audible noise shall be generated.

b. No appreciable magnetic fields shall be generated. System shall be capable of use directly in computer rooms in any location without danger to disc units, disk packs, or tapes.

c. Operating Conditions:

1) 30 – 130 Degrees F.

2) 15 – 85 Percent Humidity Non-Condensing.

d. Enclosure: Unit shall have a NEMA 1 enclosure.

H. Electrical Requirements:

1. General Requirements:

a. Rated for a 208Y/120 volt, 60 Hertz, 3 phase, 4 wire.

b. Surge Suppressors shall be in accordance with the following requirements:

1) Unit shall be parallel in design and connect in parallel to panelboard. Each surge suppression element (MOV) shall be individually fused so that a failure of one element and/or fuse shall not affect other surge suppression elements.
2) Unit shall provide maximum UL 1449 Third Edition Suppressed Voltage Rating (SVR), for the 120/208V system:
   a) L-N = 400V.
   b) L-G = 400V.
   c) N-G = 400V.
   d) L-L = 800V.
3) Unit shall provide maximum surge rating of 65,000 amperes based on ANSI/IEEE C62.41, standard 8 by 20 microsecond current waveform.
4) Unit shall have a short-circuit current rating (amperes interrupting capacity) which equals or exceeds that of the panelboard.
5) Unit shall include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status and operational integrity of each phase of the unit.
6) Unit shall be UL 1283 listed as an electromagnetic interference filter and provide 50 Ohm noise attenuation of at least 30dB at 100 kHz, 50 dB at 1 MHz, 50 dB at 10 MHz, and 45 dB at 100 MHz.
7) Unit shall have a Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of SPD status.

I. Installation:

1. General Requirements:
   a. The SPD will be mounted internal/external to the panelboard as close as possible to the panelboard neutral lug and wired to the panelboard through a 30 amp, 3-pole breaker that will serve as a maintenance disconnect. Lead lengths shall be as short as possible, preferably less than 18”.
   b. System shall be installed in accordance with the manufacturer’s printed instruction to maintain warranty. All local and national codes shall be observed.

2.20 ACCESS PANELS

A. Provide access panels for access to concealed junction boxes and to other concealed parts of system that require accessibility for operation and maintenance. In general, electrical work shall be laid out so access panels are not required.

B. Access panels shall be located in a workmanlike manner in closets, storage rooms, and/or other non-public areas, positioned so that junction can be easily reached and size shall be sufficient for purpose (minimum size 12” x 16”). When access panels are required in corridors, lobbies, or other habitable areas, they shall be located as directed.

C. Access panels shall be prime-painted and equipped with screwdriver operated cam locks.

D. Acceptable Manufacturers:

1. Inland Steel Products Company – Milcor

2. Miami Carey

3. Walsh-Hannon-Gladwin, Inc. – Way Locator

4. Specific Types:
   a. Acoustical Tile Ceiling “Milcor Type AT”
   b. Plastered Surfaces “Milcor Type K”
   c. Masonry Construction “Milcor Type M”
   d. Drywall Construction “Milcor Type DW”

E. Furnish access panel Shop Drawings.

2.21 EMERGENCY RESPONDER RADIO COVERAGE SYSTEM

A. Scope of Work:

1. Retain a qualified and experienced design build vendor to design, furnish, install, connect and test the Emergency Responder Radio Coverage system that is acceptable to the local Emergency Responders (e.g. fire/emergency medical, law enforcement that will respond to the building users), Authorities Having Jurisdiction; and in compliance with 780 CMR Chapter 9 requirements, NFPA 72 requirements, and local Emergency Responders requirements.

2. Provide full fire survivability of the Emergency Responders distribution system cabling and primary equipment in accordance with NFPA 72.

3. The system shall include all necessary hardware, equipment, cabling, antennas, power supplies, mounting methods, sleeves, software, peripheral devices and all accessories required for a complete and operating Emergency Responder Radio Coverage for all buildings and structures in the project scope.

4. Provide a dedicated 120 volt 20 amp branch circuit from the normal/emergency panelboard to the equipment.

5. Provide fire alarm system supervisory monitoring of primary Emergency Responders Radio equipment status for loss of AC power, signal loss, low battery indication and battery charger.

B. Manufacturer’s Representative and Design Build Vendor Qualifications:

1. The Electrical Subcontractor shall provide, at the appropriate time or as directed by Architect, the on-site services of a competent factory trained Engineer of the manufacturer of the Emergency Responder radio coverage equipment to inspect, test, adjust and place in proper operating condition any and all items of the same manufacturer. No additional compensation will be allowed for such services. A written report shall be issued by the particular manufacturer with his findings for the Architect’s record.

2. All final connections, testing and adjusting of the system shall be done under the direct supervision of the system supplier. After completion of the installation, a trained technician employed by the system supplier shall demonstrate the system to the satisfaction of the Owner’s representative and shall make all additional adjustments to the system operation by the Owner’s representative as a result of this demonstration.

3. The design build vendor shall be the primary equipment amplifier manufacturer’s certified

dealer and factory trained service representative, that has the resources to support a project of this scale, qualified and experienced with the local Emergency Responder Radio system requirements and able to offer full Maintenance Service Agreement to maintain such a system.

C. Performance Requirements for Emergency Responder Radio System:

1. The intent is to provide an Emergency Responder Radio Coverage system in compliance with local Emergency Responders requirements, 780 CMR Chapter 9 requirements and NFPA 72.

2. The following information herein shall be considered as minimal performance requirements to be superseded with the latest standards, regulations, and performance requirements from the Emergency Responders serving the property. Consult with the relevant local Emergency Responders and Authority Having Jurisdiction, to determine all requirements including any specific transmit/receive radio frequencies and protocols, prior to bid.

3. Signal Strength:

   a. The Emergency Radio Coverage system shall be an integral component of the life safety equipment of a building or structure. The primary function shall be to provide reliable local Emergency Responders communications at the required signal strength within the specified areas.

   b. The system shall be required to provide coverage at the specified level by the Authority Having Jurisdiction, with a minimum of within 95% of a building's floor area and also 95% of the stairwells. This Section is responsible to provide signal strength in a 100% of the building's floor area and stairwells if unable to determine specific local requirements prior to bid.

   c. The system must provide a signal strength per the requirements of the Emergency Responders, with a minimum of the following:

      1) A minimum signal strength of -95 dBm available in at least 95% if the area of each floor when transmitted from the Emergency Responders.

      2) A minimum signal strength of -95 dBm received at the Emergency Responders system from at least 95% of the area of each floor of the building.

4. Permissible Emergency Responder Radio Coverage System:

   a. Systems shall be provided with an FCC Certificated Amplifier(s) as needed, with specific bi-directional frequency band ranges and FCC Class Type to match with Emergency Responders radio equipment.

   b. The distribution system may utilize a radiating cable system or an internal multiple antenna system. Fire survivability of the distribution system cabling shall be in compliance with NFPA 72.

   c. The downlink pass band of the system shall have a center frequency(s) required by the Emergency Responders.

   d. The uplink pass band of the system shall have a center frequency(s) required by the Emergency Responders.

   e. The system as installed must comply with all applicable sections of FCC Rules Part 22, Part 90 and Part 101.

5. Backup Power:

a. The system shall be capable of operating on an independent battery backup with time duration required by the Authority Having Jurisdiction, with a minimum of at least 24 hours.

b. The battery system shall automatically charge in the presence of external power input.

6. Cabinet:

a. The primary equipment including the bi-directional amplifier(s) shall be installed in a NEMA 4 painted steel cabinet. The color shall be “Fire Engine Red” and bear the lettering as follows: “EMERGENCY RESPONDER RADIO COVERAGE SYSTEM” in bright yellow, unless indicated otherwise by the Authority Having Jurisdiction. Submit all nomenclature and designations to the local Fire Department for approval.

b. The maintenance vendor and telephone number shall be marked on the cabinet. The cabinet shall have a locking mechanism to keep the unit secure.

7. Primary Power:

a. Connection to primary power shall be with metallic conduit (hard-wired).

b. Each bi-directional amplifier shall be powered by a dedicated 20A-1P circuit.

8. System Monitoring:

a. Each amplifier unit shall have a monitoring system that monitors amplifier operation and primary power. A failure shall activate an audible device and white strobe light. The audible signal may be silenced but the strobe light shall remain illuminated until the fault has been corrected.

b. The strobe light shall be located in a common area. A sign shall be located at the strobe light with the name and telephone number of the equipment Maintenance Contractor.

c. Provide fire alarm system monitor modules to monitor equipment failure as a supervisory condition on the fire alarm system.

9. Antenna Distribution Network:

a. Provide a complete list of transit and receive frequencies along with an Intermodulation (IM) Study and other design documentation for the permit application.

b. The IM Study content shall be in accordance with the requirements by the Authorities Having Jurisdiction with the minimum of the following calculations: IM=Q*F, IM=F1+F2=F3, IM=F1+F2-F3, IM=Q1*F1+Q2*F2, and IM=Q1*F1-Q2*F2 for all frequencies uplink and downlink. These calculations shall be done to the 5^{th} order or higher if required.

D. Wiring and Raceways:

1. Wiring: All system wiring and raceways shall meet the requirements of the Code and as recommended by the Emergency Responder Radio Coverage system manufacturer.

PART 3 – EXECUTION

3.1 BASIC REQUIREMENTS

A. Adhere to best industry practice and the following:

1. All work shall be concealed.

2. Route circuitry runs embedded in concrete to coordinate with structural requirements.

3. Equip each raceway intended for the future installation of wire or cable with a nylon pulling cord 3/16” in diameter and clearly identify both ends of the raceway.

4. Provide all outlet boxes, junction boxes, and pull boxes for proper wire pulling and device installation. Include those omitted from the Contract Drawings due to symbolic methods of notation.

5. Utilize lugs of the limited type to make connections at both ends of cables installed on the line side of main service overcurrent and switching devices. Provide cable limiters for each end of each service entrance cable.

6. Beyond the termination of raceways, fireproof the following:
   a. All wires and cables within pad-mounted transformer enclosure.
   b. All service feeder cables ahead of main service overcurrent protection devices, and elsewhere where not in raceways.
   c. Fireproofing of wires and cables shall be by means of a half-lapped layer of arc proof or by means of sleeving of a type specifically manufactured for the purpose. Ends of tape or sleeving shall be severed with twine. Fireproofing shall be extended up into raceways. After conductors have been finally shaped into their permanent configuration, fireproofing tape or sleeving shall be coated with silicate of soda (water glass). Fireproofing shall be applied in an overall manner to raceway groupings of conductors.

7. Provide all sleeves through fireproof and waterproof slabs, walls, etc., required for electric work.
   a. Provide waterproof sealing for the sleeves through waterproof slabs, walls, etc.
   b. Provide fireproof sealing for the sleeves through fireproof walls, slabs, etc.
   c. Provide fireproof sealing for the openings in fireproof walls, slabs, etc., resulting from removal of existing electrical sleeves, conduits, poke-thru’s etc.

8. No splicing of wires will be permitted in Fire Alarm System.

9. Bundle wiring passing through pull boxes and panelboards in a neat and orderly manner.

10. Turn branch circuits and auxiliary system wiring out of wiring gutters at 90 degrees to circuit breakers and terminal lugs.

11. In electric rooms with equipment rated 800 amps or more and over 6 feet wide that contains overcurrent devices, the Electrical Contractor shall provide a powered Exit sign at 18” AFF at each door.

12. All panelboards shall be labeled in accordance with NFPA 70 Article 408.

3.2 TESTING REQUIREMENTS & INSTRUCTIONS

A. The Electrical Subcontractor shall provide supervision, labor, materials, tools, test instruments and all other equipment or services and expenses required to test, adjust, set, calibrate, and operationally check work and components of the electrical systems and circuitry throughout

Division 26 work.

B. The Electrical Subcontractor shall pay for all tests specified in Division 26, including expenses incident to retests occasioned by defects and failures of equipment to meet Specifications, at no additional cost to the Owner. Any defects or deficiencies discovered in any of the Electrical work shall be corrected.

1. The Electrical Subcontractor shall:

   a. Replace wiring and equipment found defective (defined as failing to meet specified requirements) at no additional cost to the Owner.

   b. Submit three (3) copies of test results to the Engineer.

2. Do not void equipment warranties or guarantees by testing and checkout work. Checks and tests shall be supplemental to and compatible with the Manufacturer's installation instructions. Where deviations are apparent, obtain the Manufacturer's approved review of procedures prior to testing. Where any repairs, modifications, adjustments, tests or checks are to be made, the Contractor shall contact the Engineer to determine if the work should be performed by or with the Manufacturer's Representative.

3. Tests are to:

   a. Provide initial equipment/system acceptance.

   b. Provide recorded data for future routine maintenance and trouble-shooting.

   c. Provide assurance that each system component is installed satisfactorily and can be expected to perform, and continue to perform its specified function with reasonable reliability throughout the life of the facility.

      1) At any stage of construction and when observed, any electrical equipment or system determined to be damaged, or faulty, is to be reported to the Engineer. Corrective action by the Contractor requires prior Engineer approval, retesting, and inspection.

      2) Prior to testing and start-up, equipment and wiring shall be properly and permanently identified with nameplates, and other identification as specified in Section 3.7. Check and tighten terminals and connection points, remove shipping blocks and thoroughly clean equipment, repair damaged or scratched finishes, inspect for broken and missing parts and review and collect Manufacturer's Drawings and instructions for delivery to the Engineer. Make routine checks and tests as the job progresses to ensure that wiring and equipment is properly installed.

      3) Testing and checkout work is to be performed with fully qualified personnel skilled in the particular tests being conducted. Personnel are to have at least five (5) years of experience with tests of same type and size as specified.

      4) Inspections and tests shall be in accordance with the following applicable codes and standards as amended to date, unless otherwise specified.

         a) National Electrical Manufacturer's Association – NEMA.

         b) American Society for Testing and Materials _ ASTM.

         c) Institute of Electrical and Electronic Engineers – IEEE.

         d) National Electrical Testing Association – NETA.

         e) American National Standards Institute – ANSI.

         f) C2: National Electrical Safety Code.

g) Z244-1: American National Standard for Personnel Protection.

h) Insulated Cable Engineers Association – ICEA.

i) Association of Edison Illuminating Companies – AEIC.

j) Occupational Safety and Health Administration – OSHA.

k) OSHA Part 1910; Subpart S, 1910.308.

l) OSHA Part 1926; Subpart V, 1926.950 through 1926.960.

m) National Fire Protection Association – NFPA.

n) 70B: Electrical Equipment Maintenance.

o) 70E: Electrical Safety Requirements for Employer Workplaces.

p) 70: National Electrical Code.

q) 78: Lightning Protection Code.

r) 101: Life Safety Code.

s) Inspections and tests shall utilize the following references:

t) Contract Drawings and Specifications.

u) Contractor's Short Circuit and Construction Study, in accordance with Section 26 00 00D.

v) Manufacturer's printed test procedures for respective equipment.

4. Test Equipment:

   a. Test equipment used by the Contractor is to be inspected and calibrated.

   b. Perform calibration and setting checks with calibrated test instruments of at least twice that of the accuracy of the equipment, device, relay or meter under test. Dated calibration labels shall be visible on test equipment. Calibrations over six (6) months old are not acceptable on field test instruments. Inspect test instruments for proper operation prior to proceeding with the tests. Record serial and model numbers of the instruments used on the test forms.

5. Test Procedures:

   a. The Electrical Subcontractor is responsible for the preparation of the procedures and schedules for the work specified herein. This work is to be coordinated and compatible with both the work and schedule of the other crafts. Sequence the tests and checks so that the equipment can be energized immediately after the completion of the application tests.

   b. Submit proposed testing and checkout forms. The procedures shall provide specific instructions for the checking and testing of each electrical component of each system. Schedule tests and inspections as the job progresses. Test procedures submitted shall include job safety rules.

   c. After each electrical system installation is complete, perform the tests to determine that the entire system is in proper working order and in accordance with applicable codes, Manufacturer's instructions, Drawings, and Specifications. Tests are in addition to shop tests of individual items at the Manufacturer's plant. Perform insulation and ground resistance tests before operating tests.

   d. Perform insulation tests on electrical equipment, apparatus, cables, motors, generators, transformers, circuit breakers and switches, switchgear, motor control centers, and

similar electrical equipment, at the following items and conditions:

e. Prior to energization and/or placing into service.

f. When damage to the insulation is suspected or known to exist.

g. After repairs or modifications to the equipment affecting the insulation.

h. Where lightning or other surge conditions are known to have existed on the circuit.

i. Make openings in circuits for test instruments and place and connect instruments, equipment, and devices, required for the tests. Upon completion of tests, remove instruments and instrument connections and restore circuits to permanent condition.

j. List each circuit and measured resistance as test data. Maintain record of insulation resistance values. Identify conductor, or equipment, date that value was taken and resistance value. Arrange information in tabular form and submit to Engineer.

k. Report inspections, tests, and calibrations in writing on Engineer approved reports/forms. The recorded data form shall have the signatures of the persons conducting the tests, authorized Witnesses and the Engineer. The forms shall serve as the test and inspection checklist.

l. When the electrical tests and inspections specified or required within Division 26 are completed and results reported, reviewed, and approved by the Engineer, the Contractor may consider that portion of the electrical equipment system or installation electrically complete. The Contractor will then affix appropriate, approved, and dated completion or calibration labels to the tested equipment and notify the Engineer of electrical completion. If the Engineer finds completed work unacceptable, he will notify the Contractor in writing of the unfinished or deficient work, with the reason for his rejection, to be corrected by the Contractor. The Contractor will notify the Engineer in writing when exceptions have been corrected. The Contractor will prepare a “Notification or Substantial Electrical Completion” for approval by the Engineer following Engineer’s acceptance of electrical completion. If later in-service operation or further testing identified problems attributable to the Contractor, these will be corrected by the Contractor, at no additional cost to the Authority.

C. Specific Tests: Perform the following specified tests. De-energize and isolate equipment and cable prior to performing the tests.

D. Motors:

1. Before energizing any machine, visually inspect for serviceability. Check Manufacturer’s instruction manual for correct lubrication and ventilation. Align motor with driven equipment. Check nameplate for electrical power requirements.

2. Test run motors uncoupled or unloaded, before placing into operation. Check the motor for rotation, speed, current and temperature rise under normal load and record the results. Maintain the proper color codes for phase identifications. This may require swaps at the motor for proper rotation. Use motor phase rotation meter prior to lead connection at motor in order to minimize later swaps.

E. Grounding Systems:

1. Test main building loops and major equipment grounds to remote earth, directly referenced to an extremely low resistance (approximately 1 ohm) reference ground benchmark. Perform a visual inspection of the systems, raceway and equipment grounds to determine the adequacy and integrity of the grounding. Ground testing results shall be recorded, witnesses, and

submitted to the Engineer.

2. Perform ground tests using a low resistance, null-balance type ground testing ohmmeter, with test lead resistance compensated for. Use the type of test instrument which compensates for potential and current rod resistances.

3. Test each ground rod and measure ground resistance. If resistance is not 25 ohms or less, drive additional rods to obtain a resistance of 25 ohms or less. Submit tabulation of results to Engineer. Include identification of electrode, date of reading and ground resistance valve in the test reports.

4. Test each building and major equipment grounding system for continuity of connections and for resistance. Ground resistance of conduits, equipment cases, and supporting frames, shall not exceed 5 ohms to ground. Submit all readings to the Engineer.

5. Where ground test results identify the need for additional grounding conductors or rods that are not indicated or specified, design changes will be initiated to obtain the acceptable values. The Contractor is responsible for the proper installation of the grounding indicated and specified.

6. Wire and Cable: (All conductors originating from main switchboard and distribution panels).

   a. Before energizing any cable or wire, megger the insulation resistance of every external circuit wire to each other and to ground. Tests shall be conducted at voltages of 500 volts or lower. Continuity test each wire and cable to verify the field-applied tag per conductor. Continuity test each wire and cable to verify the field-applied tag per conductor. Minimum insulation resistance valves shall not be less than two (2) megohms.

   b. Take insulation resistance measurements for motor feeders. With motors disconnected, measure insulation resistance from load side of contactors or circuit breakers.

   c. Check cables and wires for the proper identification numbering and/or color coding.

   d. Inspect cables for physical damage and proper connection in accordance with single line diagram.

F. Power Distribution System:

1. Main Switchboard:

   a. Inspect for physical, electrical and mechanical condition.

   b. Compare equipment nameplate information with latest single-line diagram and report discrepancies in writing to Engineer within 24 hours.

   c. Check for proper anchorage, required area clearance, physical damage, and proper alignment.

   d. Inspect all doors, panels and sections for paint, dents, scratches, fit and missing hardware.

   e. Verify that fuse and/or circuit breaker sizes and types correspond to Drawings. Report deviations to Engineer in writing within 24 hours.

   f. Inspect all bus connections for high resistance. Use low resistance ohmmeter, or check tightness of bolted bus joints by calibrated torque wrench method. Refer to manufacturer’s instructions for proper torque levels.

   g. Clean entire switchgear using manufacturer’s approved methods and materials prior to

energizing system and a second time just prior to turning over system to Owner.

h. Inspect insulators for evidence of physical damage or contaminated surfaces.

i. Verify proper barrier and shutter installation and operation.

j. Verify appropriate contact lubricant on moving current carrying parts.

k. Exercise all active components.

l. Inspect all indicating devices for proper operation.

m. Perform ground resistance tests.

n. Perform insulation resistance tests on each bus section, phase-to-phase and phase-to-ground for one (1) minute. Test voltage shall be 1000 volts minimum, and insulation resistance shall be 100 megohms minimum.

o. Perform an over-potential test on each bus station, each phase-to-ground, for five (5) minutes at manufacturer's recommended potential. Test results are evaluated on a go, no-go basis by slowly raising the test voltage to the required value. The final test voltage shall be applied for five (5) minutes for DC test potentials, and one (1) minute for AC test potentials.

2. Circuit Breakers – Molded Case:

a. Circuit breaker shall be checked for proper mounting, conductor size and feeder designation.

b. Operate circuit breaker to ensure smooth operation.

c. Inspect case for cracks or other defects.

d. Check tightness of connections with calibrated torque wrench. Refer to manufacturer's instruction for proper torque levels.

e. Perform a contract resistance test or measure millivolt drop at rated current.

f. Perform an insulation resistance test at 1000 volts DC for one (1) minute from pole-to-pole and from each pole-to-ground with breaker closed and across open contract in each phase – 500V DC if circuit breaker is solid state.

g. Adjustable trip breakers shall have minimum pickup current determined by primary current injection where applicable.

h. Perform long time delay time-current characteristic tests by passing 300% rated current through each pole separately. Determine trip time.

i. Determine short time pickup and delay by primary current injection if applicable to the particular breaker.

j. Determine ground fault pickup and time delay by primary current injection if applicable to the particular breaker.

k. Determine instantaneous pickup currently by primary injection using run-up or pulse method. Clearing times shall be within four (4) cycles.

l. Verify trip unit reset characteristics.

m. Perform adjustments for final settings in accordance with breaker setting sheet if applicable to the particular breaker.

n. Compare contract resistance or millivolt drop valves to adjacent poles and similar breakers. Investigate deviations of more than 50%. Investigate any value exceeding Manufacturer's recommendations.

o. Insulation resistance shall not be less than 100 megohms.

p. Trip characteristics of adjustable trip breakers shall fall within Manufacturer's published time-current characteristic tolerance band.

q. All circuit breakers mounted in switchboards and distribution boards shall be time-current tested by primary current injection where possible, and also any remotely mounted breakers of frame size 400 ampere and larger.

r. Adjust settings and calibrate all circuit breakers as recommended in the short circuit analysis and coordination study.

3. Panelboards:

a. Inspect for physical damage and proper grounding.

b. Compare nameplate information with schedules and report any discrepancies.

c. Inspect all panelboards for cleanliness, workmanship, etc.

4. The following systems shall adhere to the general requirements of this section in addition to complying with the specific test requirements outlined in the respective sections listed:

a. Fire Alarm System.

b. Emergency Generator System.

c. Lighting Control and Dimming System.

3.3 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 (1) cable for each leg and one (1) 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, 4-wire combined branch circuit homeruns shall be provided with a #8 AWG neutral conductor.

2. Minimum conductor size shall be No. 12 AWG copper.

3. Conductors operating at 120 volts extending in excess of 100 ft. or at 277 volts extending in excess of 200 ft., or the last outlet or fixture tap shall be No. 10 AWG 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.

G. Type MC Cable Installation:

1. Where cable is permitted under the products section, the installation of same shall be done in accordance with code and the following:

a. Cable shall be supported in accordance with code. Tie wire is not an acceptable means of support. Cable supports such as Caddy WMX-6, MX-3, and clamps such as Caddy 449 shall be used. Where cables are supported by the structure and only need securing in place, then ty-raps will be acceptable. Ty-raps are not acceptable as a means of support. All fittings, hangers, and clamps for support and termination of cables shall be of type specifically designed for use with cable, i.e., romex connectors not acceptable.

b. Armor of cable shall be removed with rotary cutter device equal to roto-split by Seatek Co.; not with a hacksaw.

c. Use split “Insuliner” sleeves at terminations.

3.4 REQUIREMENTS GOVERNING ELECTRICAL WORK IN DAMP OR WET LOCATIONS

A. Outlets and outlet size boxes shall be of galvanized cast ferrous metal only.

B. The finish of threaded steel conduit shall be galvanized only.

C. Wires for pulling into raceways for lighting and appliance branch circuitry shall be limited to “THWN”.

D. Wires for pulling into raceways for feeders shall be limited to “XHHW”.

E. Plates for toggle switches and receptacles shall have gasketed snap shut covers suitable for wet locations while in use.

F. Final connections of flexible conduit shall be neoprene sheathed.

G. Apply one (1) layer of half looped plastic electric insulating tape over wire nuts used for joining the conductors of wires.

H. Enclosures, junction boxes, pull boxes, cabinets, cabinet trims, wiring troughs and the like, shall be fabricated of galvanized sheet metal, shall conform to the following:

1. They shall be constructed with continuously welded joints and seams.

2. Their edges and weld spots shall be factory treated with cold galvanizing compound.

3. Their connection to circuitry shall be by means of watertight hub connectors with sealing rings.

I. Enclosures for individually mounted switching and overcurrent devices shall be NEMA Class IV weatherproof construction.

J. The covers, doors and plates and trims used in conjunction with all enclosures, pull boxes, outlet boxes, junction boxes, cabinets and the like shall be equipped with gaskets.

K. Panels shall be equipped with doors without exception.

L. The following shall be interpreted as damp or wet locations within building confines:

1. Spaces where any designations indicating weatherproof (WP) or vapor proof appear on the Contract Drawings.

2. Below waterproofing in slabs applied directly on grade.

3. Spaces defined as wet or damp locations by Article 100 of the National Electric Code.

3.5 REQUIREMENTS GOVERNING ELECTRIC WORK IN AIR HANDLING SPACES

A. Within air handling plenums:

1. Abide by the requirements specified for electric work in damp locations within building confines.

2. All cabling and electrical equipment installed within plenums shall be listed for plenum use.

3. Exclude the installation of type NM or NMC cable.

B. In spaces within suspended ceilings used for air handling purposes, abide by the requirements specified for normal electric work conditions except:

1. Lighting fixtures recessed into the ceilings shall be certified as being suitable for this purpose.

3.6 UNDERGROUND CONDUIT BANKS

A. The Electrical work required in conjunction with underground conduit banks shall include providing all conduits.

B. Conduits for underground banks shall be:

1. Trade diameter size as indicated but in no case less than one inch.

2. Polyvinyl chloride Schedule 40 (approved for encased burial) duct, rigid steel conduit for vertical elbows and straight sections used to penetrate equipment pads, building foundation walls and concrete slabs.

C. All conduits indicated as being incorporated into conduit banks unless specifically noted as rigid steel conduits shall be encased in a concrete envelope which accommodates the indicated configuration of conduits and which encompasses dimensions as follows:

1. Outside surfaces of conduits to outside surface of envelope where reinforcement of encasement is required – 6” minimum.

2. Outside surfaces of conduits to outside surface of envelope where no reinforcement of encasement is required – 3” minimum.

3. Spacing between centerlines of conduits assigned to different categories of use primary feeders, secondary feeders, communications and signaling – 10-1/2” minimum.

4. Spacing between centerlines of conduits assigned to the same category of use – 7-1/2” minimum.

D. Reinforcement of the concrete encasement for conduit banks where required shall consist of No. 4 longitudinal reinforcing bars located 3” from the outside surface of the envelope and spaced 6”

on centers all around. No. 8 wire reinforcing hoops set 8” apart shall be used to tie the longitudinal bars together.

E. Install conduit in such a manner as to provide a minimum cover of 30 inches after final grading except the cover may be reduced to a minimum of 18 inches to:

1. Tie into existing work.

2. Pass over other underground utilities.

3. Pass over underground obstructions.

4. Assist in the avoidance of low points.

F. Increase the minimum cover where required by field conditions.

G. Lay conduit to avoid low points during run. Pitch at a minimum of 3 inches per 100 feet away from building.

H. Provide reinforcement for the concrete encasement of a conduit bank where:

1. It passes under or over underground utilities.

2. It passes under or over underground obstructions.

3. Its cover is reduced to less than 30 inches.

4. It runs through foundation walls and other building construction.

I. Concrete encasement reinforcing shall extend in each case 5 feet beyond the points at which the determining conditions terminate.

J. Bends in conduit shall have minimum radii as follows:

1. For primary feeder 15’-0” except where specifically indicated otherwise or where turning up at termination point.

2. For primary feeder turning up at termination point – 4’-0”.

K. Install conduit so that adjacent joints are staggered at least 6 inches from one another.

L. Offsets to accommodate field conditions shall be accomplished with two (2) bends of not more than ten (10) degrees each.

M. Plug both ends of all conduit stubs.

N. Seal the end of each conduit run terminating inside a building utilizing a water and gas-tight sealant manufactured specifically for the purpose.

O. After conduit has been installed with concrete encasement completed, clear each conduit of all obstructions and foreign matter by pulling a flexible mandrel (12” minimum length and a diameter 1/4" less than that of the conduit) and brush through it. In the event that obstructions are encountered in any conduit which will not permit the mandrel to pass, remove and replace the blocked section. Include in the electric work all excavation, backfilling, repair of concrete

encasement and restoration of surface at grade involved in the conduit replacement.

P. Provide a nylon cord for the pulling of cable in each conduit in which no cable is to be installed as part of the electric work.

Q. The Electrical Subcontractor shall provide all insulated racks as required for proper support of all cables and wires.

R. Provide magnetic warning tape above each full length of duct bank 12 inches below grade.

3.7 IDENTIFICATION AND TAGGING

A. Identify individually:

1. Each transformer.

2. Each panelboard.

3. Each switch and circuit breaker.

4. Each feeder, wire or cable of all systems.

5. Each switchboard.

6. Each end of nylon pullwire in empty conduit.

B. Each wire or cable in a feeder shall be identified at its terminal points of connection and in each pullbox, junction box and panel gutter through which it passes.

C. The nomenclature used to identify panelboards 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 panelboards or load centers shall be by means of engraved Lamacoid 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 Lamacoid nameplates showing 1/8” high white lettering on a black background fastened on the outside front face of the enclosure.

2. Where in panelboards or load centers without doors – same as for individually enclosed.

3. Where in panelboards 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. Phase identification letters shall be stamped into the metal of the bus bars of each phase of the main busses of each switchboard and each panelboard. The letters shall be visible from at least one (1) “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 sheetmetal “red on white” signs reading “DANGER-HIGH VOLTAGE.”

L. Equip all electric closets and the like with enameled sheet metal “red on white” signs reading “Electrical Equipment Room – No Storage Permitted”. Signs shall be mounted at clearly visible locations within the rooms.

M. Provide a sign at the service entrance equipment room indicating the type and location of all on-site emergency or standby power sources.

N. 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.

O. Prior to installing identifying tags and nameplates, submit their nomenclature for approval. Conform to all revisions issued by the Architect.

3.8 LIMITING NOISE PRODUCED BY ELECTRICAL INSTALLATION

A. Perform the following work in accordance with field instructions issued by the Architect to assure that minimal noise is produced by electrical installations due to equipment furnished as part of the Electrical work.

B. Check and tighten the fastenings of sheet metal plates, covers, doors and trims used in the enclosures of electrical equipment.

C. Remove and replace any individual device containing one or more magnetic flux path metallic cores (e.g., discharge lamp ballast, transformer, reactor, dimmer, solenoid) which is found to have a noise output exceeding that of other identical devices installed at the project.

3.9 SUPPORTS AND FASTENINGS

A. Support work in accordance with best industry standards, Local Electric Code and the following:

1. Include supporting frames or racks for equipment, intended for vertical surface mounting, which is required in a freestanding position.

2. Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members. They shall be rigidly bolted or welded together and adequately braces to form a substantial structure. Racks shall be of ample size to assure a workmanlike

arrangement of all equipment mounted on them.

3. No work intended for exposed installation shall be mounted directly on any building surface. In such locations, flat bar members or spaces shall be used to create a minimum of ¼" air space between the building surfaces and the work. Provide ¾" thick exterior grade plywood painted with two (2) coats of fire-retardant gray paint for mounting of panelboards.

4. Nothing (including outlet, pull and junction boxes and fittings) shall depend on electric conduits, raceways or cables for support.

5. Nothing shall rest on, or depend for support on, suspended ceiling media.

6. Support less than 2" trade size, vertically run, conduits at intervals no greater than 8'. Support such conduits, 2-1/2" trade size or larger, at intervals no greater than they story height, or 15', whichever is smaller.

7. Where they are not embedded in concrete, support less than 1" trade size, horizontally run, conduits at intervals no greater than 7'. Support such conduits, 1" trade size or larger, at intervals no greater than 10'.

8. Support all lighting fixtures directly from structural slab, intermediate decking or framing member as directed by the Architect. No light fixtures shall be supported directly from the roof deck.

9. Where fixtures and ceilings are such as to require fixture support from ceiling openings frames, include in the electric work the members necessary to tie back the ceiling opening frames to ceiling suspension members or slabs so as to provide actual support for the fixtures noted above.

10. Support all runs of conduit and/or circuitry directly from structural slabs, intermediate decking or framing members.

11. Fasten electric work to building structure in accordance with the best industry practice.

12. Floor mounted equipment shall not be held in place solely by its own dead weight. Include floor anchor fastenings in all cases.

13. For items which are shown as being ceiling mounted at locations where fastenings to the building construction element above is not possible, provide suitably auxiliary channel or angle iron bridging tying to building structural elements.

14. As a minimum procedure, where weight applied to the attachment points is 100 lbs. or less, fasten to concrete and solid masonry with bolts and expansion shields.

15. As a minimum procedure, where weight applied to building attachment points exceed 100 lbs., but is 300 lbs. or less, conform to the following:

    a. At field poured concrete slabs, utilize inserts with 20' minimum length slip-through steel rods, set transverse to reinforcing steel.

3.10 SPLICING AND TERMINATING WIRES AND CABLES

A. Maintain all splices and joints in removable cover boxes or cabinets where they may be easily inspected.

B. Locate each completed conductor splice or joint in the outlet box, junction box, or pull box containing it, so that it is accessible from the removal cover side of the box.

C. Join solid conductors No. 8 AWG and smaller by securely twisting them together and soldering, or by using insulated coiled steel spring “wire nut” type connectors. Exclude “wire nuts” employing non-expandable springs. Terminate conductors No. 8 AWG and smaller by means of a neat and fast holding application of the conductors directly to the binding screws or terminals of the equipment or devices to be connected.

D. Join, tap and terminate standard conductors No. 6 AWG and larger by means of solder sleeves, taps, and lugs with applied solder or by means of bolted saddle type or pressure indent type connectors, taps and lugs. Exclude connectors and lugs of the types which apply set screws directly to conductors. Where equipment or devices are equipped with set screw type terminals which are impossible to change, replace the factory supplied set screws with a type having a ball bearing tip. Apply pressure indent type connectors, taps and lugs utilizing tools manufactured specifically for the purpose and having features preventing their release until the full pressure has been exerted on the lug or connector.

E. Except where wire nuts are used, build up insulation over conductor joints to a value, equal both in thickness and dielectric strength, to that of the factory applied conductor insulation. Insulation of conductor taps and joints shall be by means of half-lapped layers of rubber tape, with an outer layer of friction tape; by means of half-lapped layers of approved plastic electric insulating tape; or by a means of split insulating casings manufactured specifically to insulate the particular connector and conductor, and fastened with stainless steel or non-metallic snaps or clips.

F. Exclude splicing procedures for neutral conductors in lighting and appliance branch circuitry which utilize device terminals as the splicing points.

G. Exclude joints or terminations utilizing solder in any conductors used for grounding or bonding purposes.

H. Exclude all but solder or pressure indent type joints in conductors used for signaling or communication purposes.

I. Lugs for conductors used to make phase leg connections on the line side of the main service overcurrent and switching device shall be of the limiter type.

3.11 PULLING WIRES INTO CONDUITS AND RACEWAYS

A. Delay pulling wires or cables in until the project has progressed to a point when general construction procedures are not liable to injure wires and cables, and when moisture is excluded from raceways.

B. Utilize nylon snakes or metallic fish tapes with ball type heads to set up for pulling. In raceways 2” trade size and larger, utilize a pulling assembly ahead of wires consisting of a suitable brush followed by a 3-1/2” diameter ball mandrel.

C. Leave sufficient slack on all runs of wire and cable to permit the secure connection of devices and equipment.

D. Include circular wedge-type cable supports for wires and cables at the top of any vertical raceway longer than 20 feet. Also include additional supports spaced at intervals which are no greater than 10’. Supports shall be located in accessible pull boxes. Supports shall be of a non-deteriorating insulating material manufactured specifically for the purpose.

E. Pulling lubricants shall be used. They shall be products manufactured specifically for the purpose.

F. Slack on wires and cables located in cabinets and pull boxes shall be formed and set in place in groupings corresponding to their occupancy of raceways. They shall also be arranged, with insulators and supports provided where necessary, such that cable shims or other such temporary expedients do not have to be left permanently in place to prevent the wires and cables from shifting when covers or trims are removed.

3.12 REQUIREMENTS FOR THE INSTALLATION OF JUNCTION BOXES, OUTLET BOXES AND PULL BOXES

A. Flush wall-mounted outlet boxes shall not be set back to back but shall be offset at least 12” horizontally regardless of any indication on the Contract Drawings.

B. Locate all boxes so that their removable covers are accessible without necessitating the removal of parts of permanent building structure, including piping, ductwork, and other permanent mechanical elements.

C. In conjunction with concealed circuitry, abide by one of the following instructions (as may be applicable to the conditions) in order to assure the aforementioned accessibility. (Not required for circuitry concealed by removable suspended ceiling tiles.)

1. For a small (outlet size) box on circuitry concealed in a partition or wall, locate box or fitting so that its removable cover side, (or the face of any applied raised cover) penetrates through to within 1/8” of the exposed surface of the building materials concealing the circuitry and apply a blank or device plate to suit the functional requirements.

2. For a large box on circuitry concealed in a partition, suspended ceiling, or wall, locate box totally hidden but with its removable cover directly behind an architectural access door or panel (included for the purpose, separate from the electric work) in the building construction which conceals the circuitry.

3. For a small (outlet size) box on circuitry concealed above and intended as an outlet for a surface mounted lighting fixture or other such electrical item, locate box so that its removable cover side penetrates through to the exposed surface of the building materials concealing the circuitry. Arrange the mounting of the lighting fixture or other item so that it completely covers the opening in the building construction caused by the box.

4. For a small (outlet size) box on circuitry concealed in a suspended ceiling, and intended as an outlet for a non-demountable type of recessed lighting fixtures or other such electrical items, locate box totally hidden but with its removable cover not more than 1’ away from the building construction opening occupied by the demountable items.

D. Apply junction and pull boxes in accordance with the following:

1. Include all pull boxes in long straight runs of raceway to assure that cables are not damaged when they are pulled in.

2. Include junction and pull boxes to assure a neat and workmanlike installation of raceways.

3. Include junction and pull boxes to fulfill requirements pertaining to the limitations to the number of bends permitted in raceway between cable access points, the accessibility of cable joints and splices, and the application of cable supports.

4. Include all required junction and pull boxes regardless of indications on the Contract Drawings (which, due to symbolic methods of notation, may omit to show some of them).

E. Apply outlet boxes in accordance with the following:

1. Unless noted below or otherwise specifically indicated, include a separate outlet box for each individual wiring device, lighting fixture and signal or communication system outlet component. Outlet boxes supplied attached to lighting fixtures shall not be used as replacements for the boxes specified herein.

2. A continuous row of fixtures of the end-to-end channel type, designed for “through wiring”, and wired in accordance with the specification hereinafter pertaining to circuitry through a series of lighting fixtures, may be supplied through a single outlet box.

3. A series of separate fixtures, designed for “through wiring”, spaced not more than 4’ apart, and inter-connected with conduit or raceway and circuitry which is in accordance with the Specifications hereinafter pertaining to circuitry through a series of lighting fixtures, may be supplied through a single outlet box.

4. Connection to recessed ceiling fixtures supplied with pigtails may be arranged so that more than one (1), but not more than four (4) such fixtures are connected into a single outlet box. When adopting this procedure:

   a. Utilize an outlet box no smaller than 5” square by 2-1/2” deep.

   b. Allow no fixture to be supplied from an outlet box in another room.

5. Multiple local switches indicated at a single location shall be gang-mounted in a single outlet box.

6. Include all required outlet boxes regardless of indications on the Contract Drawings (which due to symbolic methods of notation, may omit to show some of them).

F. Install junction boxes, pull boxes and outlet boxes in conjunction with concealed circuitry.

1. Exclude surface-mounted outlet boxes in conjunction with concealed circuitry.

2. Exclude unused circuitry openings in junction and pull boxes. In larger boxes each such opening shall be closed with a galvanized sheet steel plate fastened with a continuous weld all around. In small outlet type boxes, utilize plugs as specified for such boxes.

3. Close up all unused circuitry openings in outlet boxes. Unused openings in cast boxes shall be closed with approved cast metal threaded plugs. Unused openings in sheet metal boxes shall be closed with sheet metal knock-out plugs.

4. Outlet boxes for switches shall be located at the strike side of doors. Indicate door swings are subject to field change. Outlet boxes shall be located on the basis of final door swing arrangements.

5. Boxes and plaster covers for duplex receptacles shall be arranged for vertical mounting of the receptacle.

6. Equip outlet boxes used for devices which are connected to wires of systems supplied by more than one set of voltage characteristics with barriers to separate the different systems.

G. Barriers in junction and pull boxes of outlet size shall be of the same metal as the box.

1. Barriers in junction and pull boxes which are larger than outlet size shall be of the polyester resin fiberglass of adequate thickness for mechanical strength, but in no case less than 1/4" thick. Each barrier shall be mounted, without fastenings, between angle iron guides so that they may be readily removed.

3.13 LOCATING AND ROUTING OF CIRCUITRY

A. In general, all circuitry shall be run concealed except that it shall be run exposed where the following conditions occur:

1. Horizontally at the ceiling of permanently unfinished spaces which are not assigned to mechanical or electrical equipment.

2. Horizontally and vertically in mechanical equipment spaces.

3. Horizontally and vertically in electric equipment rooms.

B. Concealed circuitry shall be so located that building construction materials can be applied over its thickest elements without being subject to spalling or cracking.

C. All circuitry and raceways shall not be run within slabs. If field conditions requires raceways to be embedded in field-poured structural building construction concrete fill or slab shall conform to the following:

1. All proposed embedded raceways shall be indicated on plan and elevation and submitted to the Architect and Structural Engineer for review and written approval prior to installation. Any costs associated with the review and approval shall be borne by the Electrical Subcontractor.

2. They shall be run “single layer” with their outside surface no closer than 1” to any surface of the structural concrete.

3. They shall not be located in any configuration which places the outside surface of one closer than 3” to outside surface of another, except at tees, crosses or other single level wide angle junction points.

4. Where crossovers or close grouping are unavoidable, circuitry shall be carefully field coordinated so as not to cause structural weakness.

5. Where turned up or down into a wall or partition they shall, before entering same, be routed parallel for a long enough distance to assure that no relocation of the wall or partition will be necessary to conceal the required bend.

6. They shall be routed in such a manner as to coordinate with the structural requirements of the building.

7. They shall be routed in accordance with field instructions issued by the Architect where such instructions differ from Specifications set forth herein.

D. Circuitry run exposed shall be routed parallel to building walls and column lines.

E. Exposed circuitry located overhead shall be run in a completely accessible manner on the underside of all piping and ductwork.

F. Circuitry run in suspended ceilings shall be routed parallel to building walls, column lines, etc.

G. Circuitry shall be routed so as to prevent electric conductors from being subject to high ambient temperature. Minimum clearances from heated lines or surfaces shall be maintained as follows:

1. Crossing where uninsulated: 3”.

2. Crossing where insulated: 1”

3. Running parallel where uninsulated: 36”.

4. Running parallel where insulated: 6”.

H. Circuitry shall not be run in elevator shafts, hoistways, and the like. Where outlets for trail cables, pit lights, run be level lights, and the like, are involved, only the “final connection” outlet boxes themselves shall be located within or open into, the confines of the shaft.

I. Circuitry for miscellaneous systems indicated without notation as to location and routing shall be run as per the requirements and notations governing the adjacent light and power circuitry.

3.14 INSTALLING CIRCUITRY

A. The outside surface of circuitry, which is to be embedded in cinder concrete, shall be coated with asphaltum paint.

B. In runs of conduit or raceway including flexible limit the number of bends between cable access points to a total which does not exceed the maximum specified for the particular system. Where no such maximum is specified, limit the number to four (4) right angle bends or the equivalent thereof.

C. In each conduit or raceway assigned for the future pulling in of wires, include a nylon drag cord. In raceways 2” trade size and larger, the cord shall be pulled in utilizing a suitable brush, followed by an 85% diameter ball mandrel ahead of the cord in the pulling assembly. In the event that obstructions are encountered, which will not permit the drag cord to be installed, the blocked section of raceway shall be replaced and any cutting and patching of the structure involved in such replacement shall be included as part of the electric work.

D. Circuitry shall be arranged such that conductors of one feeder or circuitry carrying “going” current are not separated from conductors of the same feeder or circuitry carrying “return” current by any ferrous or other metal. Where not within raceways, all “going” and “return” current conductors of one feeder or circuit shall be laced together so as to minimize induction heating of adjacent metal components.

E. Sleeves used where circuitry is to penetrate waterproof slabs, decks and walls, shall be of a type selected to suit the water condition encountered in the field.

3.15 CLEANING UP

A. Upon completion of all work, and testing, thoroughly inspect all exposed portions of the installation and completely remove all exposed labels, markings, and foreign material.

B. The interior of all boxes 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.

3.16 PROJECT CLOSEOUT

A. Provide close out submittals as required herein and in SECTION 01700 - PROJECT CLOSEOUT including the following close out submittals.

1. Operation and Maintenance Manuals:

2. Record Drawings.

3. Test Reports.

4. Extra Materials.

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.

C. Telecommunications:

1. Provide ten percent (10%) spare dust covers provided to the Owner at the completion of the project.

2. Provide fifteen (15%) spare patch cables and line cord for each cable length provided.

3. Provide record drawings indicating actual cable routing and cable terminations and all required identifiers. Provide copy mounted in each telecommunications closet and the main cross connect.

D. All sketches, drawings, and charts herein are for the purpose of providing for specifications in a simplified format. Errors and omissions in such does not relieve the Contractor of the responsibility for providing a fully complete, secure and properly operating integrated instructional technology network system suitable for the intended use. Bidders must obtain a complete set of Project Drawings and Specifications to determine the full scope of work. In case of conflict the Project Drawings and Specifications shall prevail.

END OF SECTION 26 00 00

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) Existing wall mount rack on the 1st floor shall be relocated to the 2nd floor. All new and existing data cables shall be rewired to the 2nd floor.
      3) Mount new patch panels within the existing wall mount rack (if required).

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. Patch Cords
      1) Provide (1) 7’ CAT6 patch cord for each device end, and (1) 12” cord for the patch panel end.
      2) Provide (2) patch cords for each new terminated patch panel port.

B. 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.

C. Telephone system (VoIP)

1. The telephone system shall be furnished, installed and programmed by the owner.

D. 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.

1.3 SUMMARY OF WORK

A. Associated "T" drawing series attached

1.4 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.

1.5 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.

1.6 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.

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

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 and type 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

SECTION 270813 – TESTING COPPER CABLES

PART 1 - GENERAL

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

SECTION 27100 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. Panduit
   2. Approved equal

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.

1.3 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

1.4 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. Panduit
2. Approved equal

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 12” 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

SECTION 271500 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

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. Panduit

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. Panduit
      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

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. 12” 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 (1) 7-foot long Category 6 patch cords 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

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.

g. 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.

h. 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:

g. 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. 2nd Floor Multipurpose Room**:**

g. The Room shall be a multipurpose room
h. The room shall be controlled by a 10” touch panel at the front of the room
i. There shall be a single gang digital media faceplate at the front of the room.
j. There shall be a Da-Lite Advantage 133” diagonal 16:9 electric screen with low voltage control at the front of the room.
k. There shall be a Epson Powerlite L210W projector with ceiling mount and standard throw lens for the room.
l. There shall be (6) six Crestron IC6T-W-T ceiling speakers for the room. There will be a Shure wireless microphone system for the room with remote antenna mounted on the wall at the rear of the 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 Storage Room/IT closet:

g. The IT Room within the multipurpose room shall have the Audio-Visual headend cabinet.
h. There shall be a 12RU wall mount rack in the closet
i. The cabinet shall house the AV digital presentation switcher, network switches, and wireless microphone receiver
j. The cabinet shall also have a Crestron TSW1060-NC with rack mount kit for local programming.

3. 6 Person Meeting Room**:**

   g. There shall be a single gang HDMI and USB pass through faceplate at the front of the room.
   h. There shall be a 50” 4K flat panel display in the space
   i. There shall be a Chief PAC BOX behind the displays in each room
   j. There shall be a Jabra Panacast 50 integrated soundbar, microphone and camera below the display in with wall adapter.
   k. There shall be (1) wireless dongle (Anycast or approved equal)

4. 3 & 4 Person Meeting Room**:**

   g. The Rooms shall be all the same equipment
   h. There shall be a single gang HDMI and USB pass through faceplate at the front of the room.
   i. There shall be a 43” 4K flat panel display in the space
   j. There shall be a Chief PAC BOX behind the displays in each space
   k. There shall be (1) wireless dongle (Anycast or approved equal) per space

5. Multipurpose Room 105**:**

   g. The room shall be controlled the display’s remote control
   h. There shall be a 65” 4K flat panel display in the room
   i. There shall be a Chief PAC BOX behind the displays in the room
   j. There shall be (1) wireless dongle (Anycast or approved equal).

6. Multipurpose Room 107**:**

   g. The rooms shall be controlled the display’s remote control
   h. There shall be a single gang HDMI and USB pass through faceplate at the front of the room.
   i. There shall be a 98” 4K flat panel display in the room
   j. There shall be a Chief PAC BOX behind the displays in the room
   k. There shall be (1) wireless dongle (Anycast or approved equal).

7. Multipurpose Room 120**:**

   g. The rooms shall be controlled the display’s remote control
   h. There shall be a single gang HDMI and USB pass through faceplate at the front of the room.
   i. There is an existing 55” Samsung (p/n: UN55TU7000F) flat panel display in the room to be relocated to an adjacent wall. Provide new mount. Refer to AV drawings for additional information.
   j. There shall be a Chief PAC BOX behind the display in the room
   k. There shall be (1) wireless dongle (Anycast or approved equal).
   There shall be (9) nine Crestron IC6T-W-T ceiling speakers for the room power by an Crestron Amp X300.
   l. There will be a voice lift system, Shure wireless microphone system for the room with remote antenna mounted on the wall at the rear of the room. There shall be (1) Lapel microphone with body pack, (1) handheld microphone with body pack and (1) charging station for both body packs and microphones.

8. Headend Room in Gym Storage Room:

   g. The storage room off of the gym shall have the Audio-Visual headend cabinet for multipurpose room 120.
   h. There shall be a 12RU wall mount rack in the closet
   i. The cabinet shall house the amp, network switches, and wireless microphone receiver
   j. Contractor shall provide an add alternate price for sound connection to the existing display. Provide Extron MLC+400 wall controller and Extron IN1608XIMA70 presentation switcher.

9. Resilience Hub**:**

   g. The rooms shall be controlled the display's remote control
   h. There shall be a single gang HDMI and USB pass through faceplate at the front of the room.
   i. There shall be a 98" 4K flat panel display in the room
   j. There shall be a Chief PAC BOX behind the display in the room
   k. There shall be a Jabra Panacast 50 integrated soundbar, microphone and camera below the display in with wall adapter.
   l. There shall be (1) wireless dongle (Anycast or approved equal).

10. Provide (3) Meeting Owl 3 to be deployed throughout the facility.

11. Provide (8) wireless dongles for deployment throughout the facility. Wireless dongle shall be Anycast or approved equal.

12. 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.

13. 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:

g. Description of the configuration and operation of the proposed system.

h. Outline drawings of all proposed equipment in plan and elevation views including overall dimensions, weights and clearances required.

i. 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:

    g. 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:

    g. Major Failure: 4 hour maximum response time if notified by telephone, 24 hours per day, 365 days per year.

h. Minor Failure: 24 hours maximum response time if notified by telephone, 365 days per year.

4. Failures are defined as follows:

g. 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.

h. 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.

i. 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:

g. Note equipment layouts, locations and control points.

h. Review each system.

i. Review system design operation and philosophy.

j. Review areas served by equipment.

k. Identify color codes used.

l. Review features and special functions.

m. Review maintenance requirements.

n. Review operation and maintenance manuals.

o. 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:

g. Universal hole pattern on the front and rear flanges, and threaded mounting holes on both sides of rack assembly for management brackets.

h. 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.

i. The rack shall support a minimum 2000 lb. Static load capacity

j. Mounting brackets specifically designed to support the equipment installed within the rack.

k. 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.

l. Hook and loop (Velcro®) cable strain relief system on rear of rack to support horizontal and backbone cables. Tie-wraps are specifically prohibited.

m. Hook and loop (Velcro®) horizontal and vertical cable management on front of rack for dressing patch cable. Tie-wraps are specifically prohibited.

n. 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.

o. Bonding and grounding cables for all equipment not directly bolted to equipment rack.

p. All hardware, supplementary steel, channel and supports as required properly assembling the rack and supporting it as necessary.

q. 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 INPUT PLATES:

A. The input plates shall be single gang faceplate- Extron MLC Plus 400 (price as add alternate)

B. Provide category 6 4 pair UTP 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 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

2.7 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.

g. Audio Matrix/Mixer

h. Audio Amplifier

i. Video Matrix

j. Single Cable Transmission

k. Control Processor

2. Built-In Device Configuration Software
g. 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

g. 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

g. Built-in video matrix switching allows video sources to be routed simultaneously to output connectors.

h. Internal switcher shall support routing of HDMI and other AV sources to HDMI and HDBaseT outputs.

i. The HDMI outputs are compatible with DVI and the HDBaseT outputs are compatible with HDBaseT and manufacturer proprietary format supporting additional control functionality.

j. 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.

g. 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:

g. 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

g. 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

g. 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

g. 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

g. 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
    g. 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

g. Gateway shall support presentation of content from network connected devices.

2. Architecture

g. Gateway functionality shall be a built-in function.

3. Communication

g. 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

g. Gateway shall support connection of up to 32 user devices for presentation.

h. 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

g. Audio Format: Stereo

6. Video

g. Video Frame Rate Supported: 15 fps (typical)

h. 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

2.8 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

2. Or approved equal

2.9 PROJECTION SCREEN

1. The Projector Screens shall conform to the following:

g. The projector screens shall be an electric ceiling mounted with low voltage control faceplate at 48”

h. The projection screens shall be 133” nominal Diagonal with a black drop of 2.00 inches, a viewable height of 69.25 and a viewable width of 116”

i. The projection screens shall be Matte white with a standard bottom border

j. The projection screens case shall be white, the case length shall be 125.5” with flange. Provide SCB-100 in internal junction box with VPI

k. The projector shall be controlled by the presentation switcher and touch panel at the front of the room.

l. Provide all mounting hardware and supports. Coordinate power and exact location in the meeting room with the architect.

Acceptable Manufacturer: Da-Lite Advantage Deluxe

2.10 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 ULXD4Q Digital Wireless System.
Provide (1) SMB8 handheld microphone
(1) MX184 lapel microphone with UXD-1 body pack
(1) Shure UA874 remote antenna and cable.
(1) Shure SBC 203 charger

2.11 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.

2.12 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
   g. Connection to AC mains
   h. Connection to a LAN.
5. The amplifier shall have front panel LED status indicators
   g. Fault
   h. Over Current
   i. DC
   j. Thermal
   k. High impedance output selected
6. The amplifier shall have a series of front panel LED output indicators
   g. Indicating signal Clip
   h. 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
    g. Operational 50-60Hz, 100-240VAC.

C. Audio I/O
   g. The amplifier shall provide 8 balanced input connections, line level
   h. The amplifier shall provide 8 speaker level output connections
   i. The amplifier shall provide 70V high impedance outputs for distributed speaker systems
   j. High impedance outputs shall be direct coupled
   k. High impedance mode selection shall be available in the Amplifier software tool
   l. 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:
      g. Stereo grouping of adjacent channel pairs
      h. Bridging of adjacent channel pairs
      i. Output level control
      j. Mute
      k. 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

B. The network switch shall have the following features:
   1. 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

   2. 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

3. 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.
   g. Refer to AV drawings for additional information.

2. Contractor shall provide (3) Meeting Owl 3 for deployment throughout the facility.
   g. 360 fisheye camera
   h. 8 omni-directional beamforming smart mics
   i. Three built-in speakers
   j. USB-C connection

2.15 DISPLAYS

A. Refer to GENERAL Section for additional Manufacturer's requirements.

B. The displays for the multipurpose room 105 shall be 65" 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:

   g. 1-displayport 1.2 DVI-D
   h. 2-HDMI 2.0
   i. HDCP 2.2
   j. 2-USB 2.0
   k. RS232

4. The displays shall have a dimension of 57.2" x 32.7" x 1.8" and 300 x 300 vesa mount

5. Acceptable Manufacturer
   g. Samsung QH65R
   h. Sony BZ40L
   i. Or approved equal

C. The displays for the Multipurpose Rooms 107 and Resilience Hub shall be 98" diagonal, 4K UHD with RS232C control

1. The displays shall have a native resolution of 3840x2160 with a brightness of 780 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:

   g. 1-displayport 1.2 DVI-D in/out
   h. 4-HDMI 2.0
   i. USB-C
   j. RS232

4. The displays shall have a dimension of 86 5/8” x 49 1/2 x 3 3/8” and 600 x 400 vesa mount

5. Acceptable Manufacturer
   g. Sony 98BZ53L
   h. Or approved equal

D. The displays for the 6 person meeting room shall be 50” diagonal 4K UHD with 232C control. The displays for the 3 & 4 person meeting room shall be 43” diagonal 4K UHD with 232C control.

E.

1. The displays shall have a native resolution of 3840x2160 with a brightness of 350 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:

   g. 1-displayport 1.2 DVI-D
   h. 3-HDMI 2.0
   i. HDCP 2.3
   j. 2-USB 2.0
   k. RS232

4. The displays shall have a dimension of 50”: 44 3/8” x 25 3/4” x 2.7/8” and 200 x 200 vesa mount, 43”: 38 3/8” x 22 3/8” x 2.7/8” and 200 x 200 vesa mount

5. Acceptable Manufacturer
   g. Sony EZ20L
   h. 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):

g. Material and labor for each item.

h. Follow the Architects cost estimate format and breakdown (request a copy from the Architect through the General Contractor).

i. Each major piece of equipment.

j. Other equipment by category.

k. Equipment installation by category and each major piece of equipment.

l. Underground work.

m. Roughing work.

n. Finish work.

o. Coordination.

p. General Conditions.

q. Bond.

r. Testing.

s. Owner training.

t. Operation and Maintenance Manuals.

u. Record drawings.

v. 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

SECTION 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 comprises of an existing Sonitrol solution. The Sonitrol system shall be expanded to accommodate new devices. The IDS system entails 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. Sonitrol
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-DO1-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