Conway Education Center
Roof Replacement

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SECTION 011000 - SUMMARY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Contract description.
2. Work by Owner or other Work at the Site.
3. Owner-furnished products.
4. Contractor's use of Site and premises.
5. Future work.
6. Work sequence.
7. Owner occupancy.
8. Permits.
9. Specification conventions.

1.2 CONTRACT DESCRIPTION

A. Work of the Project includes construction or alteration per the project documents. Including but not limited to:
1. Existing low slope roofing removal and disposal which includes ballast, built-up roofing, insulation, gutters and downspouts, facia trim, wood blocking, nailers, etc.
2. Removal of existing dedicated RTU units, roof ventilators and dedicated exhaust fans.

B. Contract with Owner according to Conditions of Contract.

1.3 WORK BY OWNER OR OTHERS

A. If Owner-awarded contracts interfere with each other due to work being performed at the same time or at the same Site, Owner will determine the sequence of work under all contracts according to "Work Sequence" and "Contractor's Use of Site and Premises" Articles in this Section.

B. Coordinate Work with utilities of Owner and public or private agencies.

C. Work under this Contract includes:
1. Work as indicated on Drawings.

D. Items noted NIC (Not in Contract) will be furnished and installed by Owner.

1.4 OWNER-FURNISHED PRODUCTS

A. Owner's Responsibilities:
1. Arrange for and deliver Owner-reviewed Shop Drawings, Product Data, and Samples to Contractor.
2. Arrange and pay for delivery to Site.
3. Upon delivery, inspect products jointly with Contractor.
4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:
   1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.
   2. Receive and unload products at Site; inspect for completeness or damage jointly with Owner.
   3. Handle, store, install, and finish products.
   4. Repair or replace items damaged after receipt.

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

A. Limit use of Site and premises to allow:
   1. Owner occupancy.
   2. Work by Owner.

B. Construction Operations: Limited to areas indicated on Drawings.
   1. Noisy and Disruptive Operations (such as Use of Jack Hammers and other noise producing Equipment): Not allowed in close proximity to existing building during regular hours of operation. Coordinate and schedule such operations with Owner to minimize disruptions.

C. Utility Outages and Shutdown:
   1. Coordinate and schedule electrical and other utility outages with Owner.
   2. Outages: Allowed only at previously agreed upon times. In general, schedule outages at times when facility is not being used.

D. Construction Plan: Before start of construction, submit three copies of construction plan regarding access to Work, use of Site, and utility outages for acceptance by Owner. After acceptance of plan, construction operations shall comply with accepted plan unless deviations are accepted by Owner in writing.

1.6 PERMITS

A. These Specifications are written in imperative mood and streamlined form. This imperative language is directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 012300 - ALTERNATES

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 alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No.1 : roof ladders .

1. Alternate: furnish and install Roof Ladder as indicated on Drawing Detail 14/A503 and as specified in Section 05 500 Metal Fabrications.
2. Complete line item on Bid Form

B. Alternate No. 2: Mechanical Unit WMHP-41. Base Bid: furnish and install WMHP-4 as shown in Detail 2/M101 including structure and electrical.

1. Alternate: remove ductwork and diffusors as shown in Detail 2/MD101 and HVAC Demolition Key Note #7. Furnish and install WMHP-4 in location shown in Detail 3/M101, including structure, ductwork and diffusors, and electrical (refer to HVAC Renovation Key Note #7).
2. Complete line item in Bid Form

END OF SECTION 012300

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 CONTRACT DOCUMENT

A. The Contract Agreement with referenced attachments, technical specifications and drawings including all project addenda constitute the Scope of the Work.

B. Specific project requirements are included in the Contract Agreement and contain, but may include more than the following:

1. Pre-Construction Meeting
2. Construction Management
3. Conformance to applicable Codes and Laws
4. Project Schedule
5. SLED Background checks
6. Submittals
7. Record Drawings
8. Quality Control
9. Cut and Patching
10. Jobsite Supervision
11. Work site control and clean-up.
12. Material testing and Inspections
13. Warranties and Guarantees
14. Traffic Control and Safety

C. Important safety and specific Horry County School requirements are contained in the Contract Agreement and specifically Section 83 “Mandatory Safety and Conduct Requirements.”

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 UTILITY USE AND CHARGES

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

C. Requirement for temporary utilities paid for by the Owner:

1. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations at no cost to the Owner.
2. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations at no cost to the Owner.
   a. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
   b. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.4 QUALITY ASSURANCE

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

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

1.5 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.

1.6 DEFINITIONS

A. Included within the Contract agreement and within each specific specification section.

PART 2 - PRODUCTS

2.1 TEMPORARY FENCING

B. Portable Chain-Link Fencing: Minimum 2-inch , 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

2.2 TEMPORARY FACILITIES

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.

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: 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. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

C. 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. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

G. 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.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel

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

3.3 SUPPORT FACILITIES INSTALLATION

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

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

D. Parking: Provide temporary parking areas for construction personnel.

E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

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

F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

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.

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

E. 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.

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

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

3.5 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.

C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.

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

E. 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. Repair or replace street paving, curbs, and sidewalks at temporary entrances, 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 Section 017700 "Closeout Procedures."

END OF SECTION 013100

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Preconstruction video recordings.
4. Periodic construction video recordings.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
3. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph and video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within five days of taking photographs.

1. Submit photos on CD-ROM or thumb-drive . Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in file metadata tag :
   a. Name of Project.
   b. Name of Contractor.
   c. Date photograph was taken.

1.4 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1.5 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect .

1. Take 20 photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.

C. Periodic Construction Photographs: Take 50 photographs coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
2. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
3. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
4. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
5. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
6. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
7. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

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

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

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

1.5 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
9. Drawing number and detail references, as appropriate.
10. Indication of full or partial submittal.

B. Options: Identify options requiring selection by Architect.

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

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

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

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
    a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

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

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

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

1. Initial Review: Allow 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.
2. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. 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.

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

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

1.7 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
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.
4. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

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

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    a. Identification of products.
    b. Compliance with specified standards.
    c. Notation of coordination requirements.
    d. Relationship and attachment to adjoining construction clearly indicated.
    e. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.
3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
4. 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.
5. 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 one 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.

D. 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.

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

F. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
3. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.

G. Test and Research Reports:

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

d. Product and manufacturers' names.
e. Description of product.
f. Test procedures and results.
g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a 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 insufficient 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 file 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.

1.9 CONTRACTOR'S REVIEW

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

B. Contractor's Approval: Indicate Contractor's approval for each submittal with . Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required , and return.

B. 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.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

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

E. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

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

1.3 DEFINITIONS

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

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

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

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

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. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

H. 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.

1.4 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 Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply

with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

B. 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.

1.7 REPORTS AND DOCUMENTS

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

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

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

1. Name, address, telephone number, and email address of technical representative making report.
2. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.

1.8 QUALITY ASSURANCE

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

B. 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. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. 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 is similar in material, design, and extent to those indicated for this Project.

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

E. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:

1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
4. 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.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor , and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. 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.
2. Engage a qualified testing agency to perform quality-control services.
   a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. 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 locations 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 duties of Contractor.

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

E. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

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

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

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

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "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 014000

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 INFORMATIONAL SUBMITTALS

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

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

1.4 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, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide bases for supporting posts.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

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

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

3.2 INSTALLATION, GENERAL

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

1. Locate facilities to limit site disturbance as specified in Section 011000 "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.

C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: 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. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted .

D. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

E. 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.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary storage sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. 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 Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 312000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

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

D. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

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

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    a. Provide temporary, directional signs for construction personnel and visitors.

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

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

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

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

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

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

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

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

F. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

3.6 MOISTURE AND MOLD CONTROL

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

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.

5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

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. Where area is intended for landscape development, remove

soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, 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 Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
3. Section 01770 "Closeout Procedures" for submitting warranties.

1.3 DEFINITIONS

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

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

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

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

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

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

1.4 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. Resolution of Compatibility Disputes between Multiple Contractors:
   a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
   b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.5 COORDINATION

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

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 that products are undamaged and properly protected.

C. Storage:

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

1.7 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 standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to 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 in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

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

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

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

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

B. Product Selection Procedures:

1. Sole 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.
    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
2. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
    a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

2.2 COMPARABLE PRODUCTS

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

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

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 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. Installation of the Work.
3. Cutting and patching.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

1.2 QUALITY ASSURANCE

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

3.2 PREPARATION

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

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

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

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Owner.

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 Owner promptly.

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

C. 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 Owner.

3.4 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.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 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.

1.2 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:

D. Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From all authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.4 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 5 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction

photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of **5** days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
2. Complete final cleaning requirements, including touchup painting.
3. 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 10 working5 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect, Engineer and Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect and Engineer 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 the Architect and Engineer, 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. Contractor shall compensate Architect and Engineer at the firm’s standard billing rates for additional reinspections beyond the first.
2. Results of completed inspection will form the basis of requirements for final completion.

1.5 FINAL COMPLETION PROCEDURES

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

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: .
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 5 days prior to date the work will be completed and ready for final inspection and tests. Architect Engineer 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. Contractor shall compensate Architect and Engineer at the firm’s standard billing rates for additional reinspection’s beyond the first.

1.6 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Owner 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. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

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: Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

C. Construction Waste Disposal: Comply with waste disposal requirements specified.

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.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

1.3 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 and Owner will comment and determine 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.

C. Initial Manual Submittal: Submit draft copy of each manual at least 3**0** days before commencing demonstration and training. Architect **wi**ll 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 1**5 d**ays before commencing demonstration and training. Architect **wi**ll return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 1**5 d**ays of receipt of Architect's and '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 paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of

contents**,** and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch 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 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.

2.4 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.

2.5 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. Provide recording in commonly used digital format.

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. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. 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.

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

D. 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.

E. 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.

F. 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 Section 017839 "Project Record Documents."

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

END OF SECTION 017823

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.
4. Miscellaneous record submittals.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following. Site civil drawings for the final submittal shall be signed and sealed by the land surveyor registered in the state of South Carolina employed by the contractor.:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:
   a. Initial Submittal:
      1) Submit one paper-copy set(s) of marked-up record 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 one set of prints.
      2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy and annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files 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. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
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. Mark important additional information that was either shown schematically or omitted from original Drawings.
5. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

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.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders**,** record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

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 and Owner's reference during normal working hoursat all times work is being performed.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:
   a. Name of Project.
   b. Name and address of videographer.
   c. Name of Architect.

d. Name of Contractor.
e. Date of video recording.

2. At completion of training, submit complete training manual(s) for Owner's use in PDF electronic file format on compact disc.

1.5 COORDINATION

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

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

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

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 Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, 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. Operations manuals.
   b. Maintenance manuals.
   c. Project record documents.
   d. Identification systems.
   e. Warranties and bonds.
   f. 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 materials needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

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

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified instructor to prepare instruction program and facilitate manufactures approved pre-produced video training modules, and to coordinate between Contractor and Owner for number of participants, instruction times, instructional media, and location. Preproduced video recordings customized during training for actual installed equipment and systems shall be presented. Include classroom instructions and demonstrations, board diagrams, and other visual aids deemed appropriate and necessary.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   3. Owner will furnish Contractor with names and positions of participants.

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.
   3. Contractor and Installer Contact File: Using appropriate media, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
      a. Name of Contractor/Installer.
      b. Business address.
      c. Business phone number.
      d. Point of contact.
      e. E-mail address.

END OF SECTION 017900

SECTION 024119 - 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 building or structure.
2. 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.

C. Remove, Salvage and Store: Carefully detach from existing construction, in a manner to prevent damage, and store in Owner-designated location.

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

E. 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. Predemolition 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. Qualification Data: For refrigerant recovery technician.

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

C. 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. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

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

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

F. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 FIELD CONDITIONS

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

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

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

D. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation will be handled separately by Owner.
2. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished.
3. If suspected hazardous materials are encountered, do not disturb; immediately notify Owner.

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

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage 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.

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

C. 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.

D. 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.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

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.

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. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition.
4. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
b. Equipment to Be Removed: Disconnect and cap services and remove equipment.
c. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

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.
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 designated by Owner.
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 Slabs: Saw-cut perimeter of area to be demolished, then break up and remove.

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

C. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.

1. Remove existing roofing system down to substrate.
2. Engage certified thermographer to perform infra-red scan of existing cementitious wood fiber deck. Confirm that moisture content and structural integrity of existing deck are acceptable for installation of new roofing membrane. If deck is not acceptable, replace cementitious wood fiber deck in areas of renovation.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, 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.

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.

3.8 SELECTIVE DEMOLITION SCHEDULE

A. Existing Construction to Be Removed: As indicated on Drawings.

B. Existing Items to be Remove and Stored: As indicated on Drawings.

C. Existing Items to Be Removed and Reinstalled: As indicated on Drawings.

D. Existing Items to Remain: As indicated on Drawings.

END OF SECTION 024119

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof framing.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Roof framing.
3. Power-actuated anchors.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

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. ClarkDietrich.

2. Marino\WARE.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings .
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
   a. Roof Framing: Vertical deflection of 1/240 of the horizontally projected span for live loads.
3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
   a. Upward and downward movement of 1/4 inch .

B. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and ASTM C955 AISI S240.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Framing Members, General: Comply with ASTM C955 for conditions indicated.

B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: ST33H .
2. Coating: G60 , A60 , AZ50 , or GF30 .

2.4 ROOF-RAFTER FRAMING

A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch .
2. Flange Width: 1-5/8 inches , minimum.

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Bracing, bridging, and solid blocking.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.7 MISCELLANEOUS MATERIALS

A. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

2.8 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    a. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
3. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing 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. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

3.3 INSTALLATION, GENERAL

A. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

B. Install field-fabricated, cold-formed framing and securely anchor to supporting structure.

C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    a. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

3.4 INSTALLATION OF JOIST FRAMING

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.

C. Space joists not more than 2 inches from abutting walls, and as follows:

1. Joist Spacing: 16 inches .

D. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:

1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.

E. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

F. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.5 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.6 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal ladders.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Metal ladders.
2. Metal floor plate and supports.

C. Delegated Design Submittals: For ladders , including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.

2. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

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

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

D. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

D. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

2.4 MISCELLANEOUS MATERIALS

A. 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.

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

2.5 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 unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 METAL LADDERS

A. General:

1. Comply with ANSI A14.3.

B. Steel Ladders:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 3/4-inch- diameter , steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Support each ladder with welded or bolted steel brackets.
7. Galvanize and prime exterior ladders, including brackets.

2.7 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

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

2.8 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

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

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop 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.

3.2 INSTALLATION OF METAL LADDERS

A. Secure ladders to adjacent construction with the clip angles attached to the stringer.

B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.

3.3 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 061063 - EXTERIOR 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. Wood blocking and nailers .

1.3 DEFINITIONS

A. Boards: Lumber of less than 2 inches nominal in thickness and 2 inches nominal or greater in width.

B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NLGA: National Lumber Grades Authority.
2. SPIB: The Southern Pine Inspection Bureau.

1.4 ACTION SUBMITTALS

A. Product Data: For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained. For products receiving a waterborne treatment, include

statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.6 QUALITY ASSURANCE

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.

1. Factory mark each item with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent .

2.2 LUMBER

A. Hand select wood for for freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.

B. Dimension Lumber: grade and any of the following species:

1. Mixed southern pine; SPIB.

2.3 PRESERVATIVE TREATMENT

A. Pressure treat boards and dimension lumber with waterborne preservative according to AWPA U1; Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

B. Pressure treat timber with waterborne preservative according to AWPA U1; Use Category UC4a.

1. Treatment with CCA shall include post-treatment fixation process.

C. Pressure treat poles with waterborne preservative according to AWPA U1; Use Category UC4a.

1. Treatment with CCA shall include post-treatment fixation process.

D. Preservative Chemicals: Acceptable to authorities having jurisdiction.

1. Do not use chemicals containing arsenic or chromium .

E. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.

F. Application: Treat all wood unless otherwise indicated .

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

1. Use fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329 unless otherwise indicated.
2. For pressure-preservative-treated wood, use stainless steel fasteners.

B. Nails: ASTM F1667.

C. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.

D. Postinstalled Anchors: Stainless steel, or anchors 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 according to ASTM E488, conducted by a qualified independent testing and inspecting agency.

1. Stainless steel bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.5 METAL ACCESSORIES

A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.

B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.

C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

D. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

E. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. ICC-ES AC70 for power-driven fasteners.
2. "Fastening Schedule" in ICC's International Building Code.
3. "Fastener Schedule for Structural Members" and "Alternate Attachments" in ICC's International Residential Code for One- and Two-Family Dwellings.

F. Use common wire nails unless otherwise indicated. Select fasteners of size that do not fully penetrate members where opposite side is exposed to view. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads unless otherwise indicated.

END OF SECTION 061063

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof sheathing.

1.2 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 plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated plywood.

1.4 QUALITY ASSURANCE

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat all plywood unless otherwise indicated.

2.4 ROOF SHEATHING

A. Plywood Sheathing: , Exterior, Structural I sheathing.

1. Span Rating: Not less than 16/0.
2. Nominal Thickness: Not less than 15/32 inch.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M .

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 INSTALLATION OF WOOD STRUCTURAL PANEL

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:
   a. Screw to cold-formed metal framing.

END OF SECTION 061600

SECTION 070150.19 - PREPARATION FOR REROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of This Section Includes:

1. Full roof tear-off.
2. Temporary roofing.
3. Base flashing removal.
4. Disposal.

B. Related Requirements:

1. Section 011000 "Summary" for use of premises and for phasing requirements.
2. Section 015000 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for reroofing preparation.

1.2 DEFINITIONS

A. EPS: Molded (expanded) polystyrene.

B. Full Roof Tear-off: Removal of existing roofing system down to existing roof deck.

C. OSB: Oriented strand board.

D. Partial Roof Tear-off: Removal of selected components and accessories from existing roofing system.

E. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting removal Work, conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing tear-off, including, but not limited to, the following:
   a. Temporary protection requirements for existing roofing system components that are to remain.

b. Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.
c. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
d. Existing roof deck conditions requiring Architect notification.
e. Condition and acceptance of existing roof deck and base flashing substrate for reuse.
f. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing.
g. HVAC shutdown and sealing of air intakes.
h. Governing regulations and requirements for insurance and certificates if applicable.
i. Existing conditions that may require Architect notification before proceeding.

1.4 ACTION SUBMITTALS

A. Temporary Roofing Submittal: Product data and description of temporary roofing system.

1. If temporary roof remains in place, include surface preparation requirements needed to receive permanent roof, and submit a letter from roofing manufacturer stating acceptance of the temporary roof and that its inclusion does not adversely affect the new roofing system's resistance to fire and wind or specified special warranty or its FM Approvals rating.

1.5 INFORMATIONAL SUBMITTALS

A. Photographs or Video: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by reroofing operations.

1. Submit before Work begins.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with governing EPA notification regulations before beginning roofing removal.
2. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.7 FIELD CONDITIONS

A. Existing Roofing System: Built-up asphalt roofing.

B. Owner will occupy portions of building immediately below reroofing area.

1. Conduct reroofing so Owner's operations are not disrupted.
2. Provide Owner with not less than 72 hours' written notice of activities that may affect Owner's operations.

3. Coordinate work activities daily with Owner so Owner has adequate advance notice to place protective dust and water-leakage covers over sensitive equipment and furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below work area.
4. Before working over structurally impaired areas of deck, notify Owner to evacuate occupants from below affected area.
    a. Verify that occupants below work area have been evacuated before proceeding with work over impaired deck area.

C. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.

D. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

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

F. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

1. Remove only as much roofing in one day as can be made watertight in the same day.

G. Hazardous Materials:

1. It is not expected that hazardous materials, such as asbestos-containing materials, will be encountered in the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
    a. Hazardous materials will be removed by Owner under a separate contract.

1.8 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during reroofing, by methods and with materials so as not to void existing roofing system warranty.

1. Notify warrantor before proceeding with the Work.
2. Notify warrantor of existing roofing system on completion of reroofing, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect.
    a. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 TEMPORARY PROTECTION MATERIALS

A. Plywood: DOC PS 1, Grade CD, Exposure 1.

2.2 TEMPORARY ROOFING MATERIALS

A. Design and selection of materials for temporary roofing are Contractor's responsibilities.

B. Base Sheet: ASTM D4601/D4601M, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet.

C. Asphalt Primer: ASTM D41/D41M.

D. Roofing Asphalt: ASTM D312/D312M, Type III or IV.

E. Base Sheet Fasteners: Capped head, factory-coated steel fasteners, listed in FM Approvals' RoofNav.

2.3 AUXILIARY REROOFING MATERIALS

A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing and new roofing system.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Protect existing roofing system that is not to be reroofed.
2. Limit traffic and material storage to areas of existing roofing that have been protected.
3. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.
4. Comply with requirements of existing roof system manufacturer's warranty requirements.

B. Shut off rooftop utilities and service piping before beginning the Work.

C. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work.

1. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.

D. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

3.2 ROOF TEAR-OFF

A. Notify Owner each day of extent of roof tear-off proposed for that day.

B. Lower removed roofing materials to ground and onto lower roof levels, using dust-tight chutes or other acceptable means of removing materials from roof areas.

C. Remove aggregate ballast from roofing.

D. Remove pavers and accessories from roofing.

E. Remove ballast, protection mat, and EPS insulation from protected roofing membrane.

1. Discard EPS insulation .

F. Full Roof Tear-off: Where indicated on Drawings, remove existing roofing and other roofing system components down to the existing roof deck .

1. Remove substrate board vapor retarder roof insulation and cover board.
2. Remove base flashings and counter flashings.
3. Remove perimeter edge flashing and gravel stops.
4. Remove flashings at pipes, curbs, mechanical equipment, and other penetrations.
5. Remove gutters and downspouts.
6. Remove wood blocking, curbs, and nailers.
7. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry.
   a. Remove unadhered bitumen, unadhered felts, and wet felts.
8. Remove fasteners from deck or cut fasteners off slightly above deck surface.

3.3 INFILL MATERIALS INSTALLATION

A. Immediately after roof tear-off, and inspection and repair, if needed, of deck, fill in tear-off areas to match existing roofing system construction.

3.4 TEMPORARY ROOFING

A. Install approved temporary roofing over area to be reroofed.

B. Prepare temporary roof to receive new roofing according to approved temporary roofing proposal .

1. Restore temporary roofing to watertight condition.
2. Obtain approval for temporary roof substrate from roofing manufacturer and Architect before installing new roof.

3.5 BASE FLASHING REMOVAL

A. Remove existing base flashings.

1. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.

B. Do not damage metal counterflashings that are to remain.

1. Replace metal counterflashings damaged during removal with counterflashings of same metal, weight or thickness, and finish as existing.

3.6 DISPOSAL

A. Collect demolished materials and place in containers.

1. Promptly dispose of demolished materials.
2. Do not allow demolished materials to accumulate on-site.
3. Storage or sale of demolished items or materials on-site is not permitted.

B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION 070150.19

SECTION 075216

STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. SBS-modified bituminous membrane roofing.

B. Cover board.

C. Roof insulation.

1.2 RELATED SECTIONS

D. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, cants, curbs, and blocking .

E. Division 07 Section "Sheet Metal Flashing and Trim" for flashings and counter flashings.

1.3 REFERENCES

A. Roofing Terminology: Refer to the following publications for definitions of roofing work related terms in this Section:

1. ASTM D 1079 “Standard Terminology Relating to Roofing and Waterproofing.”
2. Glossary of NRCA’s “The NRCA Roofing and Waterproofing Manual.”
3. Roof Consultants Institute “Glossary of Building Envelope Terms.”

B. Sheet Metal Terminology and Techniques: SMACNA “Architectural Sheet Metal Manual.”

1.4 DESIGN CRITERIA

A. General: Installed roofing membrane system shall remain watertight; and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Roofing materials shall be compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. Installer shall comply with current code requirements based on authority having jurisdiction.

D. Wind Uplift Performance: Roofing system shall meet the intent of systems that have been successfully tested by a qualified testing and inspecting agency to resist wind uplift pressure calculated in accordance with ASCE 7.

E. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A ; UL 790, for application and roof slopes indicated.

1.5 SUBMITTALS

A. Product Data: Manufacturer's data sheets for each product to be provided.

B. Detail Drawings: Provide roofing system details and details of attachment to other Work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Crickets, saddles, and tapered edge strips, including slopes.
4. Insulation fastening and adhesive patterns.

C. Verification Samples: Provide for each product specified.

D. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturers product who is eligible to receive manufacturers special warranty.

E. Maintenance Data: Refer to Johns Manville's latest published documents on www.JM.com.

F. Guarantees: Provide manufacturer's current guarantee specimen.

G. Roofing sub-contractor shall provide a copy of the final System Assembly Letter issued by manufacturer indicating that the products and system to be installed shall be eligible to receive the specified manufacturer's guarantee when installed by a certified manufacturer contractor in accordance with our application requirements, inspected and approved by a manufacturer Technical Representative.

H. Prior to roofing system installation, roofing sub-contractor shall provide a copy of the Guarantee Application Confirmation document issued by manufacturer indicating that the project has been reviewed for eligibility to receive the specified guarantee and registered.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product who is eligible to receive the specified manufacturer's guarantee.

B. Manufacturer Qualifications: Qualified domestic U.S. owned and based manufacturer that has UL listing or accredited testing agency for roofing system identical to that used for this Project.

C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 329.

D. Test Reports:
   2. Core cut.
   3. Roof deck fastener pullout test.

F. Source Limitations: Obtain all components from the single source roofing manufacturer guaranteeing the roofing system. All products used in the system shall be labeled by the single source roofing manufacturer issuing the guarantee.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.

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.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. 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 current and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written instructions and guarantee requirements.

1.9 GUARANTEE

A. Provide manufacturer's system guarantee equal to Johns Manville's Peak Advantage No Dollar Limit Roofing System Guarantee.

   1. Single-source special guarantee includes roofing plies, base flashings, liquid applied flashing, roofing membrane accessories, roof insulation, fasteners, adhesives, cover board, walkway products , and other approved single-source components of roofing system marketed by the manufacturer.
   2. Guarantee Period: 30 years from date of Substantial Completion.

B. Installer’s Guarantee: Submit roofing Installer's guarantee, signed by Installer, covering Work of this Section, including all components of roofing system, for the following guarantee period:

   1. Guarantee Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BASE PLY AND CAP-SHEET MATERIALS

A. Roofing Membrane Sheet: SBS-modified base and interplay asphalt sheet; smooth surfaced; suitable for application method specified.

1. ASTM D 6164, Grade S, Type [I] or [II], polyester-reinforced, Basis of design: DynaLastic 180 S.

B. Roofing Membrane Cap Sheet: SBS-modified asphalt sheet; granular surfaced; suitable for application method specified.

3. ASTM D 6162, Grade G, Type [I] or [III], composite polyester- and glass-fiber-reinforced, Basis of design: DynaKap FR T1

2.2 FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D 4601, Type II, asphalt-impregnated and coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides. Basis of design: PermaPly 28
5.

C. Flashing Sheet: SBS-modified asphalt sheet; granular surfaced; suitable for application method specified.

1. ASTM D 6164, Grade G, Type [I] or [II], polyester-reinforced, Basis of design: DynaLastic 180 FR**.**

D. Liquid Applied Flashing: A liquid and fabric reinforced flashing system created with a stitch bonded polyester scrim and a two-component, moisture cured, elastomeric, liquid applied flashing material, consisting of an asphalt extended urethane base material and an activator. Basis of design: PermaFlash System.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with built-up roofing.

B. Roofing Asphalt: ASTM D 312-15, Type IV.

C. Asphalt Primer: ASTM D 41. Basis of design: JM Asphalt Primer

D. Asphalt Roofing Cement: ASTM D 4586, type I, asbestos free, of consistency required by roofing system manufacturer for application. Basis of design: MBR Utility Cement

E. Cold-Applied Flashing Adhesive: Roofing system manufacturer's asphalt-based, one-part, asphalt-based, trowel-grade mastic, cold-applied adhesive specially formulated for compatibility and use with flashing applications. Basis of design: MBR Utility Cement

F. Cold-Applied Adhesive: ASTM D3019, Type III, Grade 2. asphalt-based, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with membrane applications. Basis of design: MBR Cold Application Adhesive.

J. Mastic Sealant: As required by Johns Manville.

K. Fasteners: Factory-coated steel fasteners and metal plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roofing membrane components to substrate, tested by manufacturer for required pullout strength, and provided by the roofing system manufacturer. Basis of design: High Load Fasteners and Plates.

L. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, with anchors. Basis of design: JM Termination Systems

M. Roofing Granules: Ceramic-coated roofing granules matching specified cap sheet, provided by roofing system manufacturer. Roofing Granules.

N. Seam Coating: Asphalt bleed-out coverage or aesthetic touch ups on modified bitumen and built-up cool roof coated cap sheets. Basis of design: JM CR Seam Coating

O. Self-Adhered Primer: One-part penetrating primer solution to enhance the adhesion of self-adhering membranes. Basis of design: SA Primer Low VOC.

P. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

2.4 REFLECTIVE COATING

A. Elastomeric Coating: ASTM D 6083. A multipurpose, acrylic elastomeric coating for use over a variety of substrates. Basis of design: TopGard 4000.

D. Base Coat: One-part acrylic elastomeric with bleed-blocking properties for coating over asphalt surfaces. Basis of design: TopGard Base Coat.

2.5 WALKWAYS

A. Walkway Pads: Mineral-granule-surfaced, reinforced modified asphalt composition, slip-resisting pads, manufactured as a traffic pad for foot traffic provided by roofing system manufacturer, with a pad size of 32-inch x 32-inch. Basis of design: DynaTred Walkway.

2.6 COVER BOARD

B. Gypsum Board: ASTM C 1177, Heavy duty coated glass-mat facer , water-resistant gypsum substrate for adhered roof applications, 1/4 inch (6 mm) thick. Basis of design: Dens Deck Prime Roof Board.

2.7 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.

C. **BASIS OF DESIGN -** Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 3 (25 psi), Basis of design: ENRGY 3 25 PSI**.**
1. Provide insulation package with minimum R Value: 20.
2. Provide insulation package in multiple layers.
3. Minimum Long-Term Thermal Resistance (LTTR): 5.7 per inch.

Determined in accordance with CAN/ULC S770 at 75ºF (24ºC)

D. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved wall assembly.

2.8 TAPERED INSULATION

A. Tapered Insulation: ASTM C 1289, Type II, Class 1, Grade 3 (25 psi), provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48), unless otherwise indicated. Basis of design: Tapered ENRGY 3 25 PSI.

2.9 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Provide saddles, crickets, tapered edge strips, and other insulations shapes where indicated for sloping to drain. Fabricate to slopes indicated. Basis of design: Tapered Fesco Edge Strip.

C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and furnished by roofing system manufacturer. Basis of design: UltraFast Fasteners and UltraFast Plates**.**

D. Polymer Fasteners: Glass-reinforced nylon fasteners with ¼" square drive and 1” head with Galvalume®*-coated 3” metal stress plates, designed to lock into the fastener head. Fasteners designed for fastening roof insulation to substrate and furnished by roofing system manufacturer. Basis of design: Polymer Auger Fasteners and Plates

E. Urethane Adhesive: Manufacturer’s two component polyurethane adhesive formulated to adhere insulation to substrate. Basis of design: JM Two-Part Urethane Insulation Adhesive (UIA).

F. Insulation Cant Strips: ASTM C 728, perlite insulation board. Basis of design: FesCant Plus

G. Wood Nailer Strips: Comply with requirements in Division 06 Section **"**Miscellaneous Rough Carpentry**."**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with the requirements affecting performance of roofing system.

1. General:

a. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
b. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3. Concrete Decks:

a. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
b. Verify that concrete substrate is visibly dry and free of moisture.

3.2 PREPARATION

A. Clean and remove from substrate sharp projections, dust, debris, moisture, and other substances detrimental to roofing installation in accordance with roofing system manufacturer's written instructions.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

C. If applicable, prime surface of deck with primer at a rate recommended by roofing manufacturer and allow primer to dry.

D. Proceed with each step of installation only after unsatisfactory conditions have been corrected.

3.3 RE-ROOF PREPARATION

A. Remove all roofing membrane, surfacing, coverboards, insulation, fasteners, asphalt, pitch, adhesives, etc.

1. Remove an area no larger than can be re-roofed in one day.

B. Tear out all base flashings, counterflashings, pitch pans, pipe flashings, vents, sumps, and like components necessary for application of new membrane.

C. Remove abandoned equipment curbs, skylights, smoke hatches, and penetrations.

1. Install decking to match existing as directed by Owner's Representative.

D. Raise (disconnect by licensed craftsmen, if necessary) all HVAC units and other equipment supported by curbs to conform with the following:

1. Modify curbs as required to provide a minimum 8" base flashing height measured from the surface of the new membrane to the top of the flashing membrane.
2. Secure of flashing and install new metal counterflashing prior to re-installation of unit.
3. Perimeter nailers shall be elevated to match elevation of new roof insulation.

E. Immediately remove all debris from roof surface. Demolished roof system may not be stored on the roof surface.

3.4 RE-COVER PREPARATION

A. Prepare existing roof according to roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer, and requirements in this Section.

B. Tear out all base flashings, counterflashings, pitch pans, pipe flashings, vents, sumps, and like components necessary for application of new membrane.

D. Remove existing membrane per manufacturer's written instructions.

F. Remove abandoned equipment curbs, skylights, smoke hatches, and penetrations. Install decking to match existing as directed by Owner's Representative.

G. Raise, (disconnect by licensed craftsmen, if necessary) all HVAC units and other equipment supported by curbs to conform with the following:

1. Modify curbs as required to provide a minimum 8-inch base flashing height measured from the surface of the new membrane to the top of the flashing membrane.
2. Secure top of flashing and install new metal counterflashing prior to re-installation of unit.
3. Perimeter nailers shall be elevated to match elevation of new roof insulation.

H. Immediately remove all debris from roof surface. Demolished roof system may not be stored on the roof surface.

3.9 INSULATION INSTALLATION

A. Coordinate installation of roof system components so insulation and cover board are not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system manufacturer's written instructions for installation of roof insulation and cover board.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation boards with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer's written instructions. Fill gaps exceeding 1/4 inch (6 mm) with like material.

E. Install 2 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.

F. Trim surface of insulation boards where necessary at roof drains so completed surface is flush and does not restrict flow of water.

G. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces. Key Note #7. Furnish and install WMHP-4 in location shown in Detail 3/M101, including structure, ductwork and diffusors, and electrical (refer to HVAC Renovation Key Note #7).

H. Adhered Insulation: Adhere each layer of insulation to substrate as follows:
2. Install each layer using a cold fluid-applied adhesive according to roofing system manufacturer's instruction.
4. Install each layer to resist uplift pressure at corners, perimeter, and field of roof.

I. Loose Laid Insulation with Top Insulation Layer Mechanically Fastened: Loose lay insulation with staggered joints and secure top layer of insulation to deck using mechanical fasteners designed and sized for fastening specified board-type to deck type.

1. Fasten top layer to resist uplift pressure at corners, perimeter, and field of roof.

J. Loose Laid Insulation: Loose lay all layers of insulation with staggered joints.

K. Mechanically Fastened with Subsequent Layers Adhered Insulation: Secure first layer of insulation to deck using mechanical fasteners designed and sized for fastening specified board-type to deck type.

1. Fasten first layer to resist uplift pressure at corners, perimeter, and field of roof.
2. Install subsequent layers in a two-part urethane adhesive according to roofing system manufacturer's instruction.
4. Install each layer to resist uplift pressure at corners, perimeter, and field of roof.

3.10 COVER BOARD INSTALLATION

A. Coordinate installing membrane roofing system components so cover board is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system manufacturer's written instructions for installing roof cover board.

C. Install cover board with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer's written instructions. Fill gaps exceeding 1/4 inch (6 mm) with cover board.

1. Cut and fit cover board within 1/4 inch (6 mm) of nailers, projections, and penetrations.

D. Trim surface of cover board where necessary at roof drains so completed surface is flush and does not restrict flow of water.

1. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

F. Adhered Cover Board: Adhere cover board to substrate as follows:
2. Install using a cold fluid-applied adhesive according to roofing system manufacturer's instruction.
4. Install to resist uplift pressure at corners, perimeter, and field of roof.

3.11 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing membrane in accordance with roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer and requirements in this Section.

B. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.

D. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is imminent.

1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation.
2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

F. Substrate-Joint Penetrations: Prevent roofing asphalt from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.12 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

A. Install **two** modified bituminous roofing membrane sheets, and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, with the following installation method:

1. Unroll roofing membrane sheets and allow them to relax.
2. Install one lapped base sheet course and mechanically fasten to substrate according to roofing system manufacturer's written instructions.

    a. Enhance fastening rate in perimeter and corner zones according to code or manufacturer, whichever is more stringent.
    b. Side and end laps shall be installed using heat welding techniques.
    c. Fasteners in field of sheets shall be stripped in per manufacturer’s requirements prior to installing cap sheet.

4.
5. Adhere modified bituminous roofing membranes and cap sheet to substrate in cold-applied adhesive according to roofing system manufacturer’s instruction.

B. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.

1. Repair tears and voids in laps and lapped seams not completely sealed.
2. As required, apply roofing granules to cover exuded bead at laps while bead is hot.

C. Install roofing membrane sheets so side and end laps shed water.

3.13 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.
2. Backer Sheet Application: Mechanically fasten backer sheet to walls or parapets.
4. Backer Sheet Application: Adhere backer sheet to substrate in approved adhesive applied at rate required by roofing system manufacturer.
8. Flashing Sheet Application: Adhere flashing sheet to substrate in approved adhesive applied at rate required by roofing system manufacturer.

B. Extend base flashing up walls or parapets 8 inches (200 mm) above roofing membrane. Refer to manufacturer's standard flashing details.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing with a strip of glass-fiber fabric set in MBR Flashing cement.

F. Flash all penetrations using liquid applied flashing system.

3.14 EDGE METAL INSTALLATION

A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Provide edge details as indicated on the Drawings. Install in accordance with the membrane manufacturer's requirements and SMACNA's "Architectural Sheet Metal Manual."

C. Join individual sections in accordance with the membrane manufacturer's requirements and SMACNA's "Architectural Sheet Metal Manual”.

3.15 COATING INSTALLATION

A. Ensure that all surfaces are clean, dry and free of any dirt, grease, oil or other debris that may interfere with proper adhesion.

B. Apply coating to roofing membrane and base flashings as recommended by the manufacturer. Apply in two coats allowing the first coat to completely dry before applying the second coat.

3.16 WALKWAY INSTALLATION

B. Walkway Cap Sheet Strips: Install roofing membrane walkway cap sheet strips over roofing membrane in cold-applied adhesive .

C. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions in locations indicated, to form walkways.

3.17 FIELD QUALITY CONTROL

A. Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical representative to inspect roofing installation on completion and submit report to Architect.

C. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.18 PROTECTION AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075216

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof-drainage sheet metal fabrications.
2. Low-slope roof sheet metal fabrications.
3. Miscellaneous sheet metal fabrications.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 075216 " and 055000 " for materials and installation of sheet metal flashing and trim integral with roofing.
3. Section 077100 "Roof Specialties" for manufactured copings, roof-edge specialties, roof-edge drainage systems, reglets, and counterflashings.

1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of 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, flashings, and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of coping and roof edge flashing that is FM Approvals approved.

B. 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.

B. Special warranty.

1.7 QUALITY ASSURANCE

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.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

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 Delta E units when tested in accordance with ASTM D2244.
   b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to 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 are not to rattle, leak, or loosen, and are to 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. FM Approvals Listing: Manufacture and install roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-120 . Identify materials with name of fabricator and design approved by FM Approvals.

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 , ambient; 180 deg F , material surfaces .

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Exposed Coil-Coated Finish:
   a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color: As selected by Architect from manufacturer's full range .
3. 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.

C. Lead Sheet: ASTM B749 lead sheet.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

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. ATAS International, Inc.
   b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
   c. Henry Company.
   d. Owens Corning.
2. Source Limitations: Obtain underlayment from single source from single manufacturer.
3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

A. 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.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

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 wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

F. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

G. 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 .

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. Hohmann & Barnard, Inc.
2. Source Limitations: Obtain reglets from single source from single manufacturer.
3. Material: Aluminum, 0.024 inch thick .
4. 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.
5. Accessories:
a. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
6. Finish: With manufacturer's standard color coating .

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

F. Seams:

1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

G. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch- long sections.
3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness .
4. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
5. Gutter Profile: Style A in accordance with cited sheet metal standard.
6. Expansion Joints: Lap type .
7. Gutters with Girth 21 to 25 Inches (530 to 640 mm): Fabricate from the following materials:
   a. Aluminum: 0.050 inch thick.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors . Shop fabricate elbows.

1. Fabricated Hanger Style: Fig. 1-35G in accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Fabricate from the following materials:
   a. Aluminum: 0.024 inch thick.

C. Splash Pans: Fabricate to dimensions and shape required and from the following materials:

1. Aluminum: 0.040 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long sections. Furnish with 6-inch- wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Joint Style: Overlapped, 4 inches wide .
2. Fabricate from the following materials:
   a. Aluminum: 0.050 inch thick.

B. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.040 inch thick.

C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

D. Flashing Receivers: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

E. Roof-Penetration Flashing: Fabricate from the following materials:

1. Lead: 4 lb .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.

7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
3. 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.
   a. Embed hooked flanges of joint members not less than 1 inch into sealant.
   b. Form joints to completely conceal sealant.
   c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
   d. Adjust setting proportionately for installation at higher ambient temperatures.
      1) Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:

1. Join sections with joints sealed with sealant.
2. Provide for thermal expansion.
3. Attach gutters at eave or fascia to firmly anchor them in position.
4. Provide end closures and seal watertight with sealant.
5. Slope to downspouts.
6. Fasten gutter spacers to front and back of gutter.
7. Anchor and loosely lock back edge of gutter to continuous eave or apron flashing.
8. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
9. Anchor gutter with straps spaced not more than 30 inches apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
10. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.

C. Downspouts:

1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Provide elbows at base of downspout to direct water away from building.

D. Splash Pans:

1. Install where downspouts discharge on low-slope roofs .
2. Set in asphalt roofing cement compatible with the substrate.

3.5 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements , sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with 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 centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.
4. Secure in waterproof manner by means of anchor and washer spaced at 12 inches o.c. along perimeter and 6 inches o.c. at corners areas unless otherwise indicated.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with butyl sealant and clamp flashing to pipes that penetrate roof.

3.6 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Reglets: Installation of reglets is specified in Section 055000. "<**Insert Section title**> ."

3.7 INSTALLATION OF MISCELLANEOUS FLASHING

A. Equipment Support Flashing:

1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
2. Weld or seal flashing with elastomeric sealant to equipment support member.

3.8 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.9 CLEANING

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.

3.10 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof-edge specialties.
2. Roof-edge drainage systems.
3. Reglets and counterflashings.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for downspout guards and downspout boots.
2. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
4. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Detail termination points and assemblies, including fixed points.
5. Include details of special conditions.

C. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

B. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section 075216.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties to 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.

B. FM Approvals' Listing: Manufacture and install roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-120. Identify materials with FM Approvals' markings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F , ambient; 180 deg F , material surfaces.

2.3 ROOF-EDGE SPECIALTIES

A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous metal receiver with integral drip-edge cleat to engage fascia cover . Provide matching corner units.

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. ATAS International, Inc.
   b. Fabral; a brand of OmniMax International.
2. Formed Aluminum Sheet Fascia Covers: Aluminum sheet, thickness as required to meet performance requirements .
   a. Surface: Smooth, flat finish.
   b. Finish: Two-coat fluoropolymer.
   c. Color: As selected by Architect from manufacturer's full range.
3. Corners: Factory mitered and mechanically clinched and sealed watertight.
4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.

B. One-Piece Gravel Stops: Manufactured, one-piece, metal gravel stop in section lengths not exceeding 12 feet , with a horizontal flange and vertical leg fascia, and concealed splice plates of same material, finish, and shape as gravel stop. Provide matching corner units.

1. Extruded-Aluminum Gravel Stops: Extruded aluminum, thickness as required to meet performance requirements.
   a. Finish: Two-coat fluoropolymer.
   b. Color: As selected by Architect from manufacturer's full range.
2. Corners: Factory mitered and mechanically clinched and sealed watertight.

2.4 ROOF-EDGE DRAINAGE SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Architectural Products Company.
2. ATAS International, Inc.
3. Berger; division of OmniMax International, Inc.
4. Castle Metal Products.
5. Cheney Flashing Company.
6. CopperCraft by Euramax.
7. Drexel Metals.
8. Merchant & Evans Inc.
9. SAF (Southern Aluminum Finishing Company, Inc.).
10. SAF Perimeter Systems Division.

B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Aluminum Sheet: 0.040 inch thick.

C. Gutter Profile: according to SMACNA's "Architectural Sheet Metal Manual."

1. Corners: Factory mitered and mechanically clinched and sealed watertight.
2. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.

D. Downspouts: Corrugated rectangular complete with smooth-curve elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Extruded Aluminum: 0.125 inch thick.

E. Splash Pans: Fabricate from the following exposed metal:

1. Formed Aluminum: 0.040 inch thick.

F. Aluminum Finish: Two-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

2.5 REGLETS AND COUNTERFLASHINGS

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. ATAS International, Inc.
2. Cheney Flashing Company.
3. Fry Reglet Corporation.
4. Heckmann Building Products, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Formed Aluminum: 0.050 inch thick.
2. Corners: Factory mitered and mechanically clinched and sealed watertight.
3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal:

1. Formed Aluminum: 0.032 inch thick.

D. Accessories:

1. 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 reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Aluminum Finish: Two-coat fluoropolymer Clear anodic .

1. Color: As selected by Architect from manufacturer's full range .

2.6 MATERIALS

A. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

2.7 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

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. ATAS International, Inc.
   b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
   c. Henry Company.
   d. Owens Corning.
2. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F.
3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F.

2.8 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
3. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.

B. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.9 FINISHES

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

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Coil-Coated Aluminum Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   a. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

E. Aluminum Extrusion Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   a. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

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. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under roof-edge specialties and reglets and counterflashings.
2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

3.3 INSTALLATION, GENERAL

A. Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder,

protective coatings, separators, underlayment's, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

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 specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.4 INSTALLATION OF ROOF-EDGE SPECIALITIES

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.5 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS

A. Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 12 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion-joint caps.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.

1. Provide elbows at base of downspouts at grade to direct water away from building.

D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in asphalt roofing cement.

3.6 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

A. Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.

C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.7 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 and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077100

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Joint sealants.

B. 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

1.5 CLOSEOUT SUBMITTALS

A. Manufacturers' special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

1.7 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.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 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. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 SILICONE JOINT SEALANTS

B. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Pecora Corporation.
   b. The Dow Chemical Company.

2.4 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Pecora Corporation.
   b. The Dow Chemical Company.

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 the following:
   a. Concrete.
   b. Masonry.
3. Remove laitance and form-release agents from concrete.

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 C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type 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.
4. Provide flush beveled joint profile at in accordance with applicable ASTM C1193.
   a.

3.4 FIELD QUALITY CONTROL

2. Evaluation of Field-Adhesion Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 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.

3.6 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.

END OF SECTION 079200

SECTION 099113 - EXTERIOR 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:

1. Primers.
2. Finish coatings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Product Schedule: Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.4 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. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 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.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. PPG Paints; PPG Industries, Inc.
3. Sherwin-Williams Company (The).
4. Valspar; a brand of The Sherwin-Williams Company.

B. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are 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, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range.

2.3 PRIMERS

A. Exterior, Alkali-Resistant, Water-Based Primer: Pigmented, water-based primer formulated for use on alkaline surfaces, such as exterior plaster, vertical concrete, and masonry.

2.4 FINISH COATINGS

B. Exterior Latex Paint, Low Sheen: Water-based, pigmented coating; formulated for alkali, mold, microbial, and water resistance and for use on exterior surfaces, such as portland cement plaster, concrete, and primed wood.

2. Gloss and Sheen Level: Manufacturer's standard low-sheen finish.

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:
5. Portland Cement Plaster: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

E. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.

F. 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 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.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

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.

3.3 INSTALLATION

A. Apply paints in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

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 instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.

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. Portland Cement Plaster Substrates:

1. Latex System :
   a. Prime Coat: exterior latex paint.
   b. Intermediate Coat: Matching topcoat.
   c. Topcoat: Exterior latex paint, low sheen.

END OF SECTION 099113

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SECTION 230501 - GENERAL HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. The Heating, Ventilation, and Air Conditioning (HVAC) work shall include, but not be limited to, the following:
   1. Heating systems
   2. Air Conditioning
   3. Air Distribution
   4. Controls and Instrumentation
   5. Balancing of Air Systems

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section.

1.3 DELINEATION OF WORK:

A. Provide all necessary coordination of information to installers who are performing work to accommodate Division 23 installations.

B. Where the Division 23 installer is required to install items which they do not purchase, they shall include for such items:
   1. The coordination of their delivery.
   2. Their unloading from delivery trucks driven in to any designated point on the property line at grade level.
   3. Their safe handling and field storage up to the time of permanent placement in the project.
   4. The correction of any damage, defacement or corrosion to which they may have been subjected.
   5. Their field assembly and internal connection as may be necessary for their proper operation.
   6. Their 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 systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.

C. Items which are to be installed by the Division 23 installer but not purchased as part of the work of Division 23 shall be carefully examined upon delivery to the project. The Division 23 installer shall provide all work necessary to properly install these items.

D. If any items have been received in such condition that their installation will require additional work beyond the project scope of the work, the A/E shall be notified in writing

within ten (10) working days of the date of delivery of the items. Any claims beyond 10 days will not be considered by the A/E.

1.4 QUALITY ASSURANCE:

A. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service. Where no specific indication as to the type or quality of material or equipment is indicated, a first-class standard article shall be furnished. All manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and, if so directed by the Engineer, be able to furnish proof of their ability to deliver this equipment by submitting affidavits supporting their claim.

B. Each major component of equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent will not be acceptable. ASME Code Ratings, UL label, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.

C. All equipment of one type (such as fans, pumps, valves, grilles, etc.) shall be the products of one manufacturer unless specifically stated otherwise.

D. Where the specifications do not list a specific model number for a manufacturer, the construction of a product shall be equal to those models specifically listed.

E. All materials with a manufacturers listed shelf life shall be used at least six months prior to the expiration of the materials' shelf life.

1.5 REQUIREMENTS OF REGULATORY AGENCIES:

A. Submit all items necessary to obtain all required permits to the appropriate Regulatory Agencies, obtain all required permits, and pay all required fees.

B. Where Codes and Standards are referenced, they shall be the date stated in these specifications or on the drawings. If none stated, they shall be the latest edition.

C. All work shall conform to the following Building Codes:
1. International Building Codes
2. National Fire Protection Association

D. All work shall conform to all federal, state, and local ordinances.

1.6 STANDARDS AND PROCEDURES

A. All work shall meet or exceed the standards and procedures of the following:
1. ADC: Air Diffusion Council
2. AGA: American Gas Association
3. AMCA: Air Moving and Conditioning Association, Inc.
4. ANSI: American National Standards Institute

5. API: American Petroleum Institute
6. ARI: American Refrigeration Institute
7. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers
8. ASME: American Society of Mechanical Engineers
9. ASTM: American Society of Testing and Materials
10. IBR: Institute of Boiler and Radiator Manufacturers
11. MSS: Manufacturers Standardization Society
12. NBBPVI: National Board of Boiler and Pressure Vessel Inspectors
13. NEMA: National Electrical Manufacturer's Association
14. OSHA: Occupational Safety & Health Administration
15. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
16. IRM: Improved Risk Mutuals

1.7 APPROVAL OF SUBSTITUTIONS:

A. Specific reference in the specifications to any article, device, product, materials, fixture, form or type of construction, etc., by name, make, or catalog number, with or without the words "or equal", shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The Contractor in such cases may, at his option, use any article, device, product, material, fixture, form or type of construction which, in the judgment of the A/E expressed in writing, is equal to that named. Where quality and other characteristics are very nearly the same, the question of determining equal materials and readily available service sometimes resolves itself to a matter of personal opinion and judgment and in these and all other cases involving the approval of materials, the opinion, judgment and decision of the A/E shall be final and bind all parties concerned.

B. Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified shall be submitted for approval in writing ten (10) calendar days prior to bid opening date to the A/E. Requests shall be accompanied by samples, literature, and information as necessary to fully identify and allow appraisal of the material or equipment. Submittals shall be concise, clear, and brief as possible. Incomplete submittals or submittals requiring lengthy research to ascertain quality will not be considered.

C. Approval of the A/E to use materials or equipment, if granted, will be in the form of a written addendum. Approved substitutions may be used at the Contractor's option. No substitutions will be allowed if substitutions are requested later than ten (10) days prior to bid opening date.

D. Items approved shall not be construed as authorizing any deviations from the plans and specifications unless such deviations are clearly indicated in the form of a letter that is enclosed with the submittals. The Contractor shall be responsible for verifying all dimensions with available space. If, in the opinion of the A/E, the physical dimensions do not permit the substituted material or equipment to be properly operated, maintained, serviced, or otherwise accessed, or the physical dimension adversely impact other components, a system's ability to be operated, maintained, serviced or otherwise accessed, the material or equipment shall be replaced at the Contractor's expense.

1.8 VERIFICATION OF DIMENSIONS AND LOCATIONS:

A. The Contractor shall visit the facility and become thoroughly familiar with all details of the work, working conditions, dimensions and clearances.

B. Notify the A/E of any discrepancy between actual conditions and conditions indicated on the contract documents that could cause changes, other than minor ones, to the installation of any systems or equipment.

1.9 EQUIPMENT CONNECTIONS:

A. The contract documents may indicate specific electrical, duct, and piping connection locations to equipment. Each manufacturer approved for bidding may have different connection arrangements. The Contractor is responsible for the modifications to and the extension of connecting components as required for the equipment provided.

B. The Contractor shall bear all costs for required changes in connection to equipment.

1.10 ROOFTOP EQUIPMENT LOCATIONS:

A. Rooftop equipment shall not be located within ten (10) feet of the roof edge. Notify the A/E in writing of any discrepancy on the plans and the ten (10) foot requirement prior to ordering equipment.

B. All roof mounted equipment shall be located so as to provide for clearance all around and above each unit equal to or greater than that recommended by the unit manufacturer's suggested services and operating clearances. Notify the A/E in writing of any circumstances that would prevent proper clearances from being provided prior to roughing-in equipment.

1.11 WORKMANSHIP:

A. Workmen shall be thoroughly experienced and fully capable of installing the work. Work shall be in accordance with the best standard practice of the trade. Work that is not of good quality will require removal and reinstallation at no additional expense to Owner.

B. All material and equipment to be installed in accordance with manufacturer's printed recommendations using recommended accessories. Retain a copy on job site and submit others for approval when required.

1.12 GUARANTEES AND WARRANTIES:

A. General:
   1. Furnish to the A/E a guarantee form, included in these specifications, signed by the Contractor and Owner agreeing to the start and end dates of all systems and equipment under warranty.
   2. All defective materials or inferior workmanship shall be replaced or repaired as directed by the Owner's representative during the guarantee period.

B. Equipment Warranties:
   1. Equipment shall be warranted by the equipment manufacturer. Where labor is included in the warranty, the manufacturer, at their option, may permit the contractor to provide the required repairs on the equipment unless specified otherwise.
   2. The equipment manufacturer shall include a written guarantee with the closeout documentation.

C. Duration Period:
   1. For work not otherwise specified, the duration shall be one year from substantial completion including all parts, labor, and other charges.
   2. The Contractor is responsible for purchasing from the equipment manufacturers any additional warranties to ensure that the equipment is warranted by the manufacturer through the duration period specified.

D. Extended Warranties:
   1. Warranty periods shall be extended where specifically stated in these specifications.
   2. The extended warranties shall meet the requirements of the base warranty unless specifically noted otherwise.
   3. The extended warranty time listed is time in addition to the base warranty period.
   4. The following systems or equipment shall be extended warranties:
      a. The environmental control system shall have a one year extended warranty.
      b. The building automation system shall have a one year extended warranty.
      c. All air conditioning compressors shall be provided with an extended 4-year warranty, including parts and delivery charges. Centrifugal and rotary compressors shall include motor, impeller or screw, and drive train.

E. Non-Warranted Items:
   1. Non durable replaceable items such as air filter media do not require replacement after the date of acceptance.

F. Warranty Repair:
   1. Repair shall take place as soon as possible but not later than the following:
      a. Items not essential for facility operation - 7 days.
      b. Items that have a small impact on facility operation - 2 days.
      c. Items that have a significant impact on the facility operation - immediately begin repairs or work necessary to minimize operational impact to Owner.
   2. The determination of the impact on the facility is solely that of the Owner and A/E.
   3. Where life safety issues are impacted, the contractor shall take all steps necessary to ensure the facility can continue to function in a safe manner.
   4. If repairs cannot be made in the required time period, temporary systems shall be installed until repairs can be completed.
   5. All costs associated with warranty work shall be borne by the contractor.

1.13 EXISTING FACILITIES:

A. The location of duct, pipe, fixtures, equipment and appurtenances for existing facilities are shown on plans to indicate the extent of work required. Exact condition shall be field verified by the contractor.

B. Work shall be performed above existing ceilings except where removal of existing ceilings is specifically identified. Where working above existing ceilings, remove existing tile/grid and reinstall existing tile/grid as necessary. Any damaged tile/grid shall be replaced at the contractor's expense.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRIOR CONDITIONS:

A. Prior to the installation of any equipment or system component, the Contractor shall review any prior work that has been completed to accommodate the equipment or system component to be installed.

B. If the prior work does not make a proper installation of any equipment or system component possible, notify the A/E prior to installation of any equipment or system component.

3.2 INSTALLATION:

A. Install all equipment and appurtenances in strict accordance with the manufacturer's recommendations and the manufacturer's shop drawings.

B. If any equipment cannot be installed in accordance with Codes, contract documents, manufacturer's recommendations and accepted practices, notify the A/E in writing prior to installation of equipment.

C. If any system component cannot be installed in accordance with Codes, contract documents and accepted practices, notify the A/E in writing prior to installation of the system component.

3.3 PROTECTION OF SYSTEMS AND EQUIPMENT:

A. Protect all materials and equipment from damage during storage at the Site and throughout the construction period. In the event of damage prior to final inspections, repair or replace damaged items as determined by the A/E, at no cost to the Owner.

B. Store equipment on elevated supports and cover them on all sides with securely fastened waterproof coverings. All equipment openings shall be securely sealed.

C. Piping shall be protected by storing it on elevated supports and capping the ends.

D. During construction, all open ends of pipe, etc. which could collect construction debris shall be properly capped.

3.4 CLEANING OF SYSTEMS AND EQUIPMENT:

A. All equipment and systems shall be cleaned of all extraneous materials to leave equipment and system finish in a new condition.

B. Where equipment and systems cannot be properly cleaned, take all measures necessary to replace or repair equipment and systems to bring back to a "like new" condition. All costs shall be borne by the Contractor.

C. All extraneous materials shall be removed on the site on a regular basis to provide access to all work as well as a safe working environment.

3.5 SUPPORT OF SYSTEMS:

A. Hanging duct, conduit, piping, or equipment from un-reinforced metal decks (i.e., metal roof deck w/o concrete), wood decks, etc. is not permitted.

B. The following methods of support are not permitted:
1. Wire hangers unless specifically indicated
2. Perforated straps
3. Vinyl or plastic straps

END OF SECTION 230501

SECTION 230502 - COMMON HVAC MATERIALS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
   1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the installation of the mechanical systems where shown on the drawings and specified hereinafter.

B. Description:
   1. Rooftop curbs shall include all supports for rooftop equipment, pipe, duct, air handling equipment and accessories.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE:

A. All work shall meet or exceed the standards and procedures (latest edition) of the following:
   1. AISC Steel Handbook

B. All work shall be applicable by mechanics normally employed in the trade. All work shall be installed in accordance with the manufacturer's recommendations.

C. Manufacturers:
   1. The following caulking manufacturers are acceptable:
      a. TREMCO
      b. Sonneborn - Contech
      c. W. R. Meadows
   2. The following acoustical sealant (gypboard) manufacturers are acceptable:
      a. USG
      b. Approved equal

PART 2 - PRODUCTS

2.1 GENERAL:

A. Unless specifically indicated otherwise, the following products or product accessories shall be provided with the indicated equipment:
   1. Filters shall be provided on all air systems to protect heat transfer components from outside air, building return air or other airstreams that could foul heat

transfer surfaces and elsewhere as indicated. Refer to Particulate Air Filtration specification.

B. Seacoast construction shall be provided where specified for a product. Refer to Special Coating specification.

2.2 FLASHING:

A. General:
1. Provide flashing and counter flashing on all pipes, ducts, conduits, and other mechanical system components which penetrate exterior walls or roofs.
2. Flashing sizes where shown are minimum sizes but in no case shall they be less than size required by roofing manufacturer.

B. HVAC Ducts and Flues:
1. See detail on plans.
2. Flashing of duct shall be fabricated from 20 gauge stainless steel sheets.

2.3 HVAC ROOF CURBS:

A. Required Locations:
1. Provide roof curb for all rooftop mechanical systems or components including, but not limited to, the following:
a. Fans
b. Elsewhere as indicated

B. Height:
1. Curbs shall be height indicated, 18 inches high, or 8 inches above top of finished roof, whichever is greater.
2. Curb shall be sloped as required to maintain a level surface for the equipment.

C. Curb Construction:
1. Curb shall be manufactured specifically for the roof type on which it is to be installed.
2. Curb shall be continuously welded.
3. Curb shall have 1-1/2 inch internal rigid insulation with 1/8 inch gasket between top of curb and equipment.
4. Curbs shall be aluminum.
5. Curbs shall be minimum 18 gauge.
6. Provide an angle on bottom of air handler curbs all around for attachment of sound barrier material.

2.4 CURB DESIGN:

A. Curb shall meet or exceed the greater of the seismic requirements and wind load requirements for this project. If no wind loads are indicated on mechanical or structural plans, the supplier shall assume 130 MPH wind load.

B. Design shall be reviewed by a registered professional engineer licensed in the state in which the project is located. The engineer's seal and signature shall be indicated on the submittals.

C. The design shall include but not be limited to:
1. Weight of load

2. Type of load (point load, center load, end reaction, etc.)
3. Safety factor (minimum of 2)
4. Curb support bearing (beam, joist, concrete roof, etc.)

2.5 FASTENERS, ANCHORS, AND ACCESSORIES:

A. Unless indicated otherwise, all fasteners, anchors, and accessories shall be metallic and manufactured in the United States.

B. Materials provided shall be considered industry standard for commercial or industrial use.

C. All materials shall be installed in accordance with the manufacturer's recommendations for the intent use and application.

D. Materials installed outdoors, in attics, in crawl spaces, in tunnels and other areas exposed to ambient temperature or humidity shall be stainless steel or hot dipped galvanized.

E. Unless otherwise specified or required by the manufacturer, bolts shall meet or exceed the following strengths:
1. Proof Load: 74 ksi
2. Yield Strength: 81 ksi
3. Tensile Strength: 105 ksi

2.6 SEALANT:

A. Exterior joint sealant shall be polyurethane base, multi-component; self-leveling type for application in vertical joints; capable of withstanding movement of up to 50% of joint width and satisfactorily handled throughout temperature of 4 to 27 degrees C.; uniform, homogeneous, and free from lumps, skins and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining; non-bleeding.

B. Penetrations and fire rated assemblies shall meet the requirements of the Firestopping and Smokestopping specification.

C. Color shall be approved by A/E.

2.7 ACOUSTICAL SEALANT (GYPBOARD):

A. General:
1. Acoustical sealant shall be provided at penetrations of all non-rated assemblies.
2. Product shall be latex based and bond with porous and non-porous materials.
3. Product shall be permanently resilient.

B. Properties:
1. Flame spread: 0
2. Smoke spread: 0
3. Viscosity: 250K - 400K CPS

C. Manufacturer shall be:
1. USG Sheetrock Brand Acoustical Sealant

PART 3 - EXECUTION

3.1 ROOF CURBS:

A. Submit shop drawings with structural engineering calculations where a seismic design is required.

B. Curb and support rail sizes and locations shall be coordinated with building and roofing installers.

C. The Contractor shall set curb and coordinate roof flashing with roofing installer. Curbs shall be fastened to building structure by welding or fasteners as required by seismic design. Equipment shall be fastened to curbs as required by seismic design.

D. Curbs shall be installed to maintain a level surface plus or minus 1/4 inch for length of curb and rail.

E. Provide curb seal or gasket on all equipment curbs.

3.2 EQUIPMENT STORAGE:

A. Facilities for storing materials and equipment shall be provided by the Contractor.

B. All equipment and materials shall be protected from ambient conditions including freezing and exposure to sunlight when these conditions could affect the product.

C. All stored items shall be elevated off slab or grade.

3.3 EXTERIOR SEALANT:

A. Submit color charts to A/E.

3.4 EQUIPMENT PENETRATIONS:

A. Seal all openings into equipment resulting from installation of equipment such as conduit and flex.

3.5 EQUIPMENT INSTALLATION:

A. Repair all insulation damaged during installation of equipment.

3.6 EQUIPMENT ATTACHMENT:

A. Equipment shall be secured to the building or structure. Where equipment is provided with a method of attachment, that method shall be used to attach the equipment. Where equipment is not provided with a method of attachment, the contractor shall add gussets, angles, or similar material to the unit without affecting the performance or warranty of the equipment, which shall be used to attach the equipment.

END OF SECTION 230502

SECTION 230503 - DEMOLITION, PATCHING AND REPAIR

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the demolition of all mechanical equipment, piping, duct, and appurtenances where indicated or shown on the drawings and specified hereinafter.
2. Furnish all labor, materials, tools and equipment and perform all operations in connection with the patching and repair of building structure, finishes and building assemblies as specified hereinafter.
3. All existing utilities, water, steam, chemical treatment, controls, etc. shall be reconnected to new systems as required to maintain the same functions as existed prior to new work.

B. Descriptions:
1. Cut openings thru the existing building walls, roof, floors, and finishes to accommodate the installation of Division 23 equipment, controls, piping, and appurtenances.
2. Remove and dispose of existing HVAC equipment, piping, and appurtenances.
3. Patch and repair all building finishes, structural components, or other appurtenances that are removed or damaged as a result of the performance of this contract. Patch and repair work shall include finishes, components, substructure and materials required for the installation of such work in accordance with standard practices.
4. All penetrations thru exterior walls, floors, and roof systems shall be sealed watertight.
5. Patched and repaired work shall be finished to match existing or adjacent construction and conditions.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section.

PART 2 - EXECUTION

2.1 GENERAL:

A. Post tensioned slabs, beams, columns and other load bearing structures shall not be drilled, cut, or otherwise modified without written approval by structural engineer.

2.2 PROTECTION:

A. Provide barricades and take all other precautionary measures necessary to protect personnel and property.

B. The Contractor shall be responsible for any damages to adjacent areas to the construction area.

C. Areas not included in the scope of work, areas where work is minimal, and, in the case of a phased contract, areas which remain inactive for long periods shall be protected from the area in which the work is being performed by a slab to slab barrier acceptable to engineer and local authorities.

D. Protect the roof at all times. Provide planking, plywood, supports, and other materials and means to ensure damage is not incurred.

E. At no time shall required means of egress be blocked by equipment materials, permanent or temporary barriers.

2.3 COORDINATION:

A. All demolition work which will interrupt building utilities or cause the disruption of the normal environment in areas of the building not within the scope of this project will be performed at other than the Owner's normal working hours.

2.4 PENETRATIONS:

A. All round penetrations shall be core drilled. All other penetrations shall be saw cut. Openings shall not be larger than required for proper installation of pipe or duct.

2.5 MATERIAL REMOVAL:

A. The Owner shall retain first right of refusal on all existing equipment, piping, and appurtenances which are to be removed as a result of this contract.

B. Coordinate demolition work with Owner using extreme care not to damage existing equipment which Owner elects to retain.

C. Remove Owner retained equipment from existing location and store equipment at a location on the site where specified by Owner.

D. All material, equipment, supports, and appurtenances not required as the result of demolition to or renovation of the building systems shall be removed from the project site and disposed of properly unless retained by Owner.

END OF SECTION 23 0503

SECTION 230510 - DOCUMENTATION AND CLOSEOUT

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Furnish all labor, materials, tools and equipment and perform all operations in connection with the project documentation and closeout.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL:

A. All reports, forms, and manuals shall be submitted to the A/E in triplicate unless additional copies are noted.

B. Report, forms, and manuals are to be submitted as soon as possible, but no later than thirty (30) days after the earliest date they can be prepared.

3.2 OWNER TRAINING:

A. The contractor shall schedule the training on equipment and systems at least 21 days before training is to take place. The contractor shall provide multiple dates and times for the training to allow the Owner to coordinate the schedules of their staff to be trained.

B. The contractor shall provide all training aids, manuals, etc. for the Owner’s staff at the training classes. These are in addition to whatever is required for the Operations and Maintenance manuals. The contractor shall coordinate the number required with the Owner but shall include a maximum of 8 sets for the training class.

C. The person providing the training shall be thoroughly knowledgeable in the subject matter and shall be certified by the equipment or system manufacturer.

3.3 PROJECT JOB DRAWINGS AND AS-BUILT DRAWINGS:

A. Keep a record set of drawings on the job and, as construction progresses, shall show the actual installed location of all items, material, and equipment on the project job drawings.

B. At the time of final inspection, one corrected set of prints shall be delivered to the A/E. All drawing costs to be by the Contractor.

C. As built drawings shall have the information transferred from the project job drawings including all addendum, supplemental instructions, change orders, and similar information.

D. Qualified draftsmen shall perform this task.

3.4 OPERATING AND MAINTENANCE MANUAL:

A. Compile and bind three (3) sets of all manufacturer's instructions and descriptive literature on all items of equipment furnished under this work. Additionally, provide this information on a CD in PDF format.

B. Binder shall be hard cover, three-ring notebook, embossed with the name of the project, 11" x 8-1/2" with heavy duty rings. Maximum binder size shall be 2-1/2". Use multiple binders as necessary.

C. The spine of the binder shall be titled “HVAC Operating and Maintenance Manual, Volume No. X," with the name of the project and the date under the title.

D. The Operating and Maintenance Manual shall include the following:
1. Cover sheet in each binder listing the architect, engineer, and all contractors. List addresses and contact information.
2. List name, address and phone number of organization responsible for warranty work, if other than Contractor, and the specific work for which he is responsible.
3. List name, address and phone number of the nearest sales and the nearest service organization for each product.
4. Schedules of all equipment including identification tag numbers shown on plans cross referenced to field applied identification tag numbers.
5. Performance Curves: For pumps, fans, balance valves, and similar equipment at the operating conditions.
6. List of Spare Parts: Recommended for normal service requirements. Each piece of equipment shall have this list clearly marked or attached to this submittal.
7. Parts List: Identifying the various parts of the equipment for repair and replacement purposes.
8. Instruction Books: May be standard booklets but shall be clearly marked to indicate applicable equipment and characteristics.
9. Wiring Diagrams: Generalized diagrams are not acceptable, submittal shall be specifically prepared for this Project.
10. Automatic Controls: Diagrams and functional descriptions.
11. All start-up reports for all equipment.
12. Test and balance report.
13. Filter size list for each piece of equipment. Identify filter type, size, efficiency, and equipment tag.

E. The following diagrams, schematics, and lists shall be provided:
1. Automatic control diagrams
2. Sequences of operation

3.5 ENGINEERING FIELD REPORTS AND FINAL INSPECTION REPORTS:

A. The A/E will review the Contractor's work periodically throughout the project. A report will be submitted to the Contractor.

B. The reports shall be responded to within ten days of receipt by the Contractor. Each item shall be addressed with comments written on the inspection report if possible. Contractor's response shall address the status of each item and all discrepancies.

3.6 OPERATION AND MAINTENANCE INSTRUCTIONS:

A. After all final tests and adjustments have been completed, the Owner's Representatives shall be instructed in all details of operation and maintenance for the systems installed.

B. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive.

C. Fifty percent of instructions shall be in a formal classroom setting.

D. Instruction shall be provided as follows:
1. Equipment: Trained factory representative
2. System: Competent employee of the Contractor

3.7 CONTROLS OPERATION AND MAINTENANCE INSTRUCTIONS:

A. Upon completion of Operation and Maintenance instructions, the Owner's representative shall be instructed in all details of operation and maintenance for the controls installed.

B. Controls Operation and Maintenance Instruction shall include the entire control system including control sequences that are inherent to equipment provided by the Equipment Manufacturer including economizer cycles, burner operation, low ambient operation, freezestats and similar sequences. Provide sufficient personnel equipment, walkie-talkies, gauges, and other accessories for this work.

C. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive.

D. Fifty percent of instructions shall be in a formal classroom setting.

E. Instruction shall be provided as follows:
1. Controls System: Competent employee of the controls installer

3.8 ACCEPTANCE:

A. Upon notification by the Contractor and after completion of Operation and Maintenance Instructions, the A/E will visit the project for a demonstration of the building system and an inspection of the completed work.

B. Items which do not comply with the Contract Documents or which function incorrectly will be listed. The list will be provided by the A/E to the Contractor for correction of the installed work.

C. After all corrections have been made, the Contractor shall notify the A/E who will recheck the systems for compliance of all items listed.

PART 4 - STANDARD FORMS

4.1 GENERAL:

A. All forms shall be completely filled out by the Contractor prior to acceptance of the project by the A/E.

4.2 HVAC CLOSEOUT LIST:

HVAC CLOSEOUT DOCUMENT **PROJECT**: Conway Education Center Reroofing 1964 Portion **BGA PROJECT NO**.: 21115		
DOCUMENT	**DATE REVIEWED**	**COMMENTS**
Preliminary Test and Balance (Airside)		
Test & Balance (Airside)		
HVAC O&M Manuals (3 sets plus CD)		
As installed Control Drawings		
HVAC marked-up As-Builts (1 set red lined)		
Equipment Start-Up Reports		
Punchlist dated _____		
NOTE: Not all closeout documents may be listed. See other sections of specifications for additional requirements.		

HVAC INSTRUCTIONS TO OWNER:

HVAC INSTRUCTIONS TO OWNER

PROJECT: Conway Education Center Reroofing 1964 Portion
BGA PROJECT NO.: 21115

INSTRUCTIONS	DATE/TIME SCHEDULED	MINIMUM SPECIFIED HOURS	ESTIMATED HOURS OF INSTRUCTION	PERSONS ATTENDING	COPY OF SIGN-IN LIST SENT TO BGA
Packaged Units					

NOTE: Not all instructions may be listed. See other sections of specifications for additional requirements. Up to 8 sets of training material required. Provide per number of persons indicated. Where no minimum specified hours indicated, training shall be provided as necessary for technician to provide the Owner a good understanding of the operation, function, and maintenance requirements of the equipment or system installed.

4.3 INSTRUCTIONS TO OWNER:

OWNER INSTRUCTIONS SIGN-IN SHEET

PROJECT: Conway Education Center Reroofing 1964 Portion

BGA PROJECT NO.: 21115

SYSTEM/EQUIPMENT:	DATE	TIME		LOCATION:
		START	FINISH	

INSTRUCTORS (PRINT NAME AND SIGN)

1. _____
2. _____

ATTENDEES (PRINT NAME AND SIGN)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

WRITTEN MATERIALS PROVIDED TO ALL ATTENDEES: _____ YES _____ NO

INSTRUCTIONS IN CLASSROOM: _____ YES _____ NO

INSTRUCTIONS IN FIELD: _____ YES _____ NO

END OF SECTION 230510

SECTION 230511 - SUBMITTALS

PART 1 - GENERAL

1.1 GENERAL:

A. Refer to Division 1 specification for information and shop drawings and submittals requirements. When conflicts exist, the more stringent requirements shall apply.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section.

1.3 PREPARATION OF SUBMITTALS:

A. Before preparing submittals, consult all contract drawings and specifications in detail, obtain manufacturer's recommended installation instructions, and have shop drawings prepared based on specific equipment and material intended for installation. Obtain all drawings and submittals from other trades as necessary to coordinate submittals.

B. Sign all shop drawings indicating conformance with contract documents before submitting to the A/E.

1.4 SUBMITTALS:

A. General:
   1. Submittals are required on all items of equipment and materials.
   2. Submittals shall include but not be limited to:
      a. All requirements of Division 1.
      b. Complete information pertaining to appurtenances and accessories.
      c. Information properly marked with service or function identification as related to the project.
      d. Where the submittal consists of catalog sheets displaying other items which are not applicable, the proper features shall be clearly identified.
      e. External connections properly marked, as related to the specific use intended, on standard factory assembly and field installation drawings.
      f. All performance characteristics and physical characteristics.
      g. Wiring and control diagram.
      h. All requirements listed in the specific section of specifications.
      i. Electrical data on all motors greater than one horsepower. Data shall include horsepower unit served, power factor, efficiency and product of P.F. x EFF.

B. Field Fabricated Components:
   1. When field fabricated components are permitted by the specifications, scaled detailed drawings shall be submitted, clearly showing the materials used, dimensions, sizes, and means of assembly. For example, drawings shall be submitted for pump housings (insulation), support stands, etc.

C. Submittal Summary:
   1. A submittal summary shall be prepared by the contractor within (10) (30) (60) days of project award.
   2. The summary shall include all products and samples to be submitted along with the date the submittal will be received by the prime contractor.

1.5 SAMPLES:

A. Samples shall be provided when specified or required by the A/E to check product acceptability or for coordination purposes.

B. Samples will not be returned and shall not be included in the total required on the project.

1.6 REVIEW OF SUBMITTALS:

A. Review of shop drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless the Contractor has, in letter form, called attention to such deviations at the time of submission and secured written approval of the specific deviations.

B. Any materials and equipment listed which are not in accordance with the equipment shown on the schedule shall be of size and physical arrangement to allow unobstructed access, when installed, for routine maintenance, coil removal, shaft removal, motor removal and other similar operations. Deviation from the characteristics of that equipment or layout system components will not necessarily be cause for rejection. Review of submittal does not relieve the Contractor of his responsibility. Should an installation not meet the intent of the contract documents, the Contractor may be required by the A/E to modify or replace equipment or system components with all costs, direct and indirect, borne by the Contractor.

C. It is strongly recommended that the Contractor not purchase or install any equipment or system components prior to receipt of reviewed shop drawings.

D. Reviewed with notations on the submittal shall not prohibit the Contractor from purchasing equipment. If the Contractor does not comply with the notations, the submittal shall be deemed rejected.

1.7 EQUIPMENT DIMENSIONS AND WEIGHTS:

A. The contract documents may indicate specific equipment dimensions. The Contractor is responsible for verification of the dimensions for the equipment submitted prior to submitting shop drawings. Equipment larger than the equipment indicated on the contract documents may not be acceptable by the A/E's.

B. The contract documents may indicate specific equipment weights. The Contractor is responsible for verification of the weight of the equipment submitted prior to submitting shop drawings. Equipment weighing more than the equipment indicated on the contract documents may not be acceptable to the A/E.

C. Equipment shall not exceed maximum weight indicated on the schedules. If the equipment weight exceeds that indicated on the schedule, even where the manufacturer is an approved manufacturer, that equipment can not be bid on for this project.

D. If equipment is not acceptable to the A/E due to dimensions or weights exceeding those indicated on contract documents, the Contractor shall accept all responsibility and costs for providing equipment that meets the dimension and weight requirements of the contract documents.

1.8 ELECTRICAL CHARACTERISTICS:

A. Electrical characteristics for mechanical equipment are generally indicated on the mechanical documents. The electrical documents generally indicate power and wiring requirements to each piece of mechanical equipment.

B. It shall be the mechanical installer's responsibility to verify prior to submitting shop drawings that the equipment submitted meets the electrical requirements of both the mechanical and electrical documents. If there is a discrepancy, the contractor shall bring the discrepancy to the A/E's attention prior to submitting shop drawings.

C. If the discrepancy is brought to the A/E's attention prior to ordering the mechanical equipment or electrical materials associated with that equipment, the A/E will issue additional instructions to the Contractor.

D. If the discrepancy is not brought to the A/E's attention prior to ordering the mechanical equipment and electrical materials (i.e. Contractor does not verify electrical requirements), the Contractor shall be responsible for all costs except those that would have been incurred if the discrepancy was determined prior to ordering the mechanical equipment and electrical materials.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRODUCT SUBMITTALS:

A. The following list may be used as a checklist for the contractor and A/E. All products may not be listed.

PRODUCT SUBMITTALS

BGA NO.	PRODUCT	NO.	DATE		STATUS				ITEMS TO RESUBMIT	DATE ITEMS RESUBMITTED
			In	Out	App.	AAN	Resub.	Rej.		
	Controls									
	Curbs and Supports									
	Dampers									
	Diffusers, Registers and Grilles									
	Duct Access Doors									
	Duct Accessories									
	Duct Detectors									
	Duct Flexible Connections									
	Equipment & Pipe Identification									
	Fans									
	Insulation, Mastics, and Sealants									
	Metal Duct									
	Wall Mounted Heat Pumps									

3.2 CONTROL SUBMITTAL:

A. Control submittals shall include the following:
   1. All information necessary for a clear representative of the system to be provided.
   2. All control components.
   3. Graphical representative of all systems to be controlled.
   4. I/O summary sheets.
   5. Floor plan indicating panels.
   6. Sequence of operation. All devices referenced in the sequence shall be indicated on graphic representation.
   7. Large scale (75% reduction maximum) of all control panel faces.
   8. Wiring diagrams including interface with equipment (terminal strip, contactor, etc.).

B. All drawing submittals shall be CADD generated drawings.

C. Submit a floor plan locating all thermostats, sensors, lighting override switches, and control panels. Contractor must receive approval in writing before roughing in controls.

3.3 SHOP DRAWING SUBMITTAL COVER SHEET:

A. A separate cover sheet shall be submitted with each product type (i.e., valves can be submitted together, etc.)

3.4 SHOP DRAWING SUBMITTAL COVER SHEET

(Provide one page for each group of shop drawings.)

PROJECT NAME: Conway Education Center BGA FILE NO. 21115-3-33

PRODUCT: _____ BGA SHOP DWG. NO. _____

NOTE TO CONTRACTOR

1. All shop drawing comments by Buford Goff & Associates shall be complied with or the shop drawings shall be declared rejected.
2. If this form is not completed and signed by the Contractor and items 1 to 8 below are not answered YES or N/A, the shop drawings shall be declared rejected.
3. Dampers, grilles, valves, etc., are reviewed for characteristics but not for size and quantity. It is the Contractor's responsibility to verify sizes and quantity.

SHOP DRAWING SUBMITTAL (Contractor to complete this section)

1. Does the submittal comply with the contract documents? ☐ Yes ☐ No

   If no, list all deviations on an attached page.

2. Have the electrical characteristics (i.e., volt/phase/amps, MOP, MCA, and connection location) been reviewed with the electrical schedules and the electrical circuit sizing meet the requirements of that equipment? ☐ Yes ☐ No ☐ N/A
3. Is product an approved manufacturer listed in the specifications or addendum? ☐ Yes ☐ No ☐ N/A
4. Does the product submitted meet the manufacturer's recommended service clearance for the space in which it is to be installed? ☐ Yes ☐ No ☐ N/A
5. Have the control components of the product been reviewed and do they meet with the requirements of the controls contractor? ☐ Yes ☐ No ☐ N/A
6. Have the equipment connections been reviewed (size and locations) and has the Contractor included all provisions to make the required connections? ☐ Yes ☐ No ☐ N/A
7. Has the seismic engineer reviewed and approved the method of connecting seismic restraints to equipment? ☐ Yes ☐ No ☐ N/A
8. Is the equipment within the weight limitations specified, if any? ☐ Yes ☐ No ☐ N/A

BGA'S SHOP DRAWING STAMP (Engineer to complete this section)

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Contractor is responsible for specific compliance with the information given in the Contract Documents; dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades, and the safe and satisfactory performance of his work.

☐ Reviewed ☐ Reviewed as Noted ☐ Revise and Resubmit ☐ Revise and Resubmit Items Listed
☐ See attached for additional comments ☐ Reject

Comments: _____

_____

_____

_____ Reviewer: _____ Date: _____

END OF SECTION 230511

SECTION 230592 - SYSTEM START-UP

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the start-up of all building mechanical systems where shown on the drawings and specified hereinafter.

B. Description:
1. These systems shall include:
a. Air systems (heating, ventilating, air conditioning, exhaust and recirculation)

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
1. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC

1.3 QUALITY ASSURANCE:

A. Codes and standards:
1. All work shall meet or exceed the standards and procedures of the following (latest edition):
a. AABC National Standards
b. SMACNA

B. Start-up of equipment shall be by manufacturer's representative unless noted otherwise.

C. Tests, in addition to those specified herein, required to prove code compliance, to meet insurance requirements, and to verify proper installation by the A/E, owner, or authorities having jurisdiction shall be provided by the Contractor.

D. All tests, instruments, and procedures shall be in accordance with the AABC National Standards and system test and balance specifications.

PART 2 - PRODUCTS

2.1 GENERAL:

A. All concealed work must remain uncovered until required tests have been completed. Sections of the system may be tested prior to concealing as outlined hereinafter.

B. The Owner and the A/E shall be notified in writing a minimum of three working days prior to any tests being performed.

C. Local, state and federal authorities having jurisdiction shall be notified in writing with sufficient time to schedule inspection as required by the authority.

D. In no case shall a system be started or operated in such a manner that the system or component pressure or temperature ratings, or the pressure or temperature to which a system or component has been tested, be exceeded.

2.2 START-UP:

A. Systems shall be started up by the Contractor except as required in specific portions of the mechanical specifications.

B. The following systems shall be started up by a factory certified technician:
1. Wall mounted heating and cooling units

2.3 AIR DISTRIBUTION SYSTEMS:

A. General:
1. Cleaning and leakage testing are not required for existing duct systems unless indicated otherwise.

B. Cleaning of Duct System:
1. Upon completion of duct and before installation of any outlets, the contractor shall clean entire duct system of all rubbish, plaster, dirt, etc.

C. Leakage Tests for systems 2 inch w.g. and less:
1. Verify, by use of air monitoring devices and pitot tube traverse, that the total air quantities measured at all outlets and the air quantity handled by the fan differ by no more than $\pm$5%.
2. Where leakage is determined to exceed 5% in accordance with the above testing procedure, the Contractor shall locate and repair the duct to reduce the leakage to acceptable levels.
3. Where excessive leakage is noted at any location, whether the entire system meets the 5% leakage rate or not, the Contractor shall repair the duct to minimize the leakage at the location identified.
4. Leakage includes all connected components of the system.
5. Leakage tests shall be repeated until the duct is proven to be within the limits of leakage specified herein.

2.4 SYSTEM START-UP:

A. General:
1. System shall be started and checked to ensure safe and proper operation.

2. Minimum requirements are listed for each system and are in addition to manufacturer start-up requirements and the requirements stated in the specific sections of the specifications.
3. Temperature control systems installed complete and operable.
4. Proper thermal overload protection in place for electrical equipment.

B. Air Systems:
1. Verify proper fan rotation.
2. Verify full load amps are below nameplate amps.
3. Verify balance dampers and fire and smoke dampers are open.
4. Remove all duct restrictions.
5. Verify clean filters are installed.
6. Verify access doors are closed and duct end caps are in place.
7. All outlets shall be installed and connected.

PART 3- EXECUTION

3.1 SUBMITTALS:

A. Submit to the A/E all test results including a minimum of the following information:

1. System tested
2. Location of test
3. Date, time, and ambient temperature at test startup and completion
4. Persons present for test
5. Duration of test
6. Test equipment
7. Test results

B. Partial system may be done at the Contractor's option except tests shall be completed:
1. For each phase designated by contract documents
2. In accordance with building construction schedule for completion
3. As required to turn over portions of the system for the Owner's use

C. Reports shall include but not be limited to:
1. Tests during construction
2. Equipment start-up reports

D. Reports shall be submitted within ten days of test completion.

3.2 ENGINEER REVIEW:

A. The A/E shall, at his discretion, recheck any or all of the test work. Provide ample number of technicians and test equipment to perform the tests required.

B. All systems not accepted shall be retested.

C. Systems shall be retested and rechecked until accepted by all parties.

3.3 DUCT LEAKAGE:

A. Where leakage is determined to exceed the allowable rate, locate and repair the duct to reduce the leakage to acceptable levels.

END OF SECTION 230592

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the testing and balancing of all mechanical systems where shown on the drawings and specified hereinafter.

B. Description:
1. Systems shall include all equipment, operators, controls, accessories, and appurtenances.
2. These systems shall include:
   a. Air systems (heating, ventilating, air conditioning, exhaust and recirculation distribution systems)
3. Air inlets and outlets shall include:
   a. Exhaust
   b. Supply
   c. Return

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
1. Section 23 0592 - System Start-Up

1.3 QUALITY ASSURANCE:

A. Codes and Standards:
1. All work shall meet or exceed the standards and procedures of the following (latest editions):
   a. AABC National Standards
   b. NEBB Standards
   c. NBC Standards
2. Testing and balancing shall be performed by an agency certified by the AABC, NEBB, or the National Balancing Council.
3. All technicians shall have a minimum of three years testing and balancing. Each test and adjustment shall be under the direct supervision of a qualified technician.
4. Testing and balancing shall be performed by one agency.

PART 2 - PRODUCTS

2.1 GENERAL BALANCING PROCEDURES:

A. All recorded data shall represent a true, actually measured, or observed condition.

B. Any abnormal conditions in the mechanical systems or conditions which prevent total system balance, as observed by the Test and Balance Agency, shall be reported as soon as possible to the A/E.

C. If, for any reason, a system cannot be properly balanced, it shall be reported to the A/E by the Test and Balance Agency as soon as observed.

D. Should additional balancing devices be required, the Test and Balance Agency shall bring it to the attention of the Contractor as quickly as possible.

E. The Test and Balance Agency shall leave all system components in proper working order including:
1. Close access doors.
2. Close doors to electrical switch boxes.
3. Restore thermostats to specified settings.

F. The Test and Balance Agency shall permanently mark the settings of all valves, dampers, and other adjustment devices in a manner that will allow the settings to be restored. If a balancing device is provided with a memory stop, it shall be set and locked.

G. Systems shall be tested in each specified mode of operation. See equipment Sequence of Operation.

2.2 INSTRUMENTS:

A. All Test and Balance work shall be performed using the required instrumentation to obtain proper measurements.

B. Instruments shall be properly maintained and transported in such a manner as to provide protection against damage due to vibration, impact, moisture or any other condition that may render them inaccurate.

C. Instruments shall have been calibrated within a period of six months prior to starting the project.

D. Proof of calibration shall be maintained with the instruments.

E. Instruments shall be calibrated upon completion of the work when required by the client to prove reliability.

2.3 AIR SYSTEMS:

A. General Requirements:
1. Total system balance shall not begin until the Test and Balance Agency has verified that start-up procedures have been performed and filters have been changed.

2. The Test and Balance Agency shall measure the amperes of all fan motors before total system balance is started and shall take proper steps to correct and report any overloads.
3. The Test and Balance Agency shall not continue total system balance if any conditions are observed that are hazardous to the air system. This shall be reported and corrected before proceeding further.
4. The Test and Balance Agency shall verify all outlets for compliance with design requirements and shall report any variations before starting total system balance.
5. If during total system balance, the Test and Balance agency detects any inlet or outlet conditions that will not allow proper balancing to be performed, the A/E shall be notified immediately.
6. Reports shall indicate airflow measured at unit and inlet and outlet totals.

B. Air Outlets:
1. The systems shall be balanced so that the total supply air quantity to each space shall be within -5% to +5% of the design amount.
2. The pattern for all adjustable outlets shall be adjusted for proper distribution to minimize drafts.
3. Outlet dampers shall not be used to provide proper branch airflow to space.
4. The test and balance contractor shall indicate on the test and balance report that the grilles provide the proper directional throw where direction throws are indicated.

C. Air Inlets:
1. Inlets on systems shall be adjusted to the required quantities with a tolerance of ±5%.
2. At completion of total system balance, at least one inlet of every branch shall be fully open and at least one branch balancing damper in the system shall be fully open.
3. Return air inlets installed in ceilings where the space above the ceiling is used as a return air plenum are to be fully opened and are not to be measured or adjusted except where a specific airflow is indicated.

D. Zone Dampers:
1. Dampers installed in main trunks and branches and dampers required for system control shall be balanced within -5% to +5% of the design amount.

E. Filters:
1. Under final balanced conditions, the Test and Balance Agency shall measure and record static pressure entering and leaving each filter bank.

F. Fans:
1. The Test and Balance Agency shall set the fan RPM to provide design total CFM and the required static pressure to operate the system.
2. If proper airflow is not achieved, the Contractor shall change the belts and drives. The new drives shall be calculated by the Test and Balance Agency. The Test and Balance Agency shall reset the fan RPM to provide design total CFM.
3. Fan speed shall not exceed the maximum allowable RPM as established by the fan manufacturer.
4. The final setting of fan RPM shall not result in overloading the fan motor in any mode of operation. Dampers shall be modulated, and the amperes of the supply fan motor shall be measured to ensure that no motor overload can occur. The amperes shall be measured in the full cooling, heating, dehumidification, and economizer modes to determine the maximum brake horsepower.

5. After total system balancing, the following values shall be recorded:
   a. Fan RPM
   b. Motor voltage and amperes
   c. Entering static pressure
   d. Leaving static pressure
6. Final RPM of the constant volume supply fan shall be set to supply the required CFM with filters artificially restricted to simulate 100% loading. The Test and Balance Agency shall verify that the fan motor will not be overloaded when the system is operating with unrestricted, clean filters in place.
7. When applicable, final supply fan settings shall be based on rated wet cooling coil resistance.
8. Final RPM of the supply fan in systems having mixed air dampers shall be set to provide required CFM with the system in a logical non-modulating mode; for example, minimum outside air.

G. Coils:
1. Under final balanced conditions, the Test and Balance Agency shall measure and record static pressure entering and leaving each coil bank.

2.4 TEMPERATURE CONTROL SYSTEM:

A. In the process of Total System Balance, the Test and Balance Agency shall:
1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding to intended control performance.
2. Verify that all control devices are properly connected.
3. Check that all valves are properly installed in the piping system in relation to direction of flow and location.
4. Check the calibration of all controllers.
5. Verify the proper application of all normally open and normally closed valves.
6. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.
7. Check the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media.
8. Check that the sequence of operation for any control mode is in accordance with approved shop drawings. Verify that no simultaneous heating and cooling occurs except where specified. Observe that heating cannot take place at VAV reheat terminals until the unit is at minimum CFM.
9. Verify that all controller set points meet the design intent.
10. Check all dampers for free travel.
11. Verify the operation of all interlocked systems.
12. Perform all system verification to assure the safety of the system and its components.

2.5 TEMPERATURE MEASUREMENT:

A. General:
1. Air and water temperatures at hydronic coils must be taken in the same relative timeframe. For example, when measuring coil entering and leaving air temperatures, the coil entering and leaving water temperature must be taken in close timeframe to the measurement of the air.

2. Where outside air temperature is a variable affecting other readings (such as a mixed air temperature), the outside air reading shall be given at the time of the mixed air reading.

B. Air Temperatures:
1. Provide entering and leaving air temperatures for each cooling coil, heating coil, energy recovery and heat transfer device.
2. Temperatures shall be measured in heating, cooling, dehumidification, and neutral modes of operation.

PART 3 - EXECUTION

3.1 SUBMITTALS:

A. The Contractor shall submit to the A/E the following information within thirty days after the award of the contract:
1. The name of the Test and Balance Agency.
2. Name and registration number of the certified testing technician.

B. The Contractor shall submit to the A/E the following information within ninety days after the award of the contract.
1. Detailed testing procedures including list of instruments, task performed, model and serial number and date last calibrated.
2. Agenda including schedule of work with approximate duration of each phase, approximate date of field inspections, and required start date to meet scheduled completion date.
3. Report forms.

C. An approved copy of each submittal must be received by the Test and Balance Agency before work is begun.

D. If complete submittals are not received by the A/E within the specified times, the A/E reserves the right to select the Test and Balance Agency with any additional costs incurred by the Contractor.

3.2 REPORT SUBMITTALS:

A. Provide a preliminary typed report for engineers' review.

B. After receiving engineers' review comments and address issues, submit three copies of the Test and Balance report. Report shall have systems, subsystems, and individual readings in a sequential format.

C. Reports can be submitted in phases such as air systems, water systems, vibration, etc.

D. Reports shall be submitted after all modifications required by these specifications to balance system (i.e. replace impellers, belts, drives, dampers) have been made. Reports will not be accepted with comments such as damper missing, new drive required, etc.

3.3 COORDINATION OF WORK:

A. Test and Balance Agency shall not begin work on a system until system is started as required in SYSTEM START-UP specifications.

3.4 CONTRACTOR REVIEWS AND INSPECTIONS:

A. The Test and Balance Agency shall perform one pre-construction plan check and submit comments to A/E.

B. The Test and Balance Agency shall perform construction inspections at the following stages of each construction phase and submit comments to A/E:
1. 50% completion
2. 90% completion

3.5 DAMPERS:

A. If it is determined by the Test and Balance Agency that additional balance dampers are required, the Contractor shall install additional dampers.

B. The Test and Balance Agency shall rebalance system after changes have been made.

3.6 ENGINEER REVIEW:

A. The A/E shall, at their discretion, recheck any or all of the test and balance work within 120 days of receipt of report. The Test and Balance Agency shall provide ample number of technicians and test equipment to perform the tests required.

B. Upon completion of the A/E's recheck, the testing and balancing report, or portions thereof, shall be accepted or rejected. All parts not accepted shall be retested and rebalanced.

C. Systems shall be tested, rebalanced and rechecked until accepted by all parties.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of insulation required for thermal and acoustical installation on all mechanical equipment, piping, ductwork, and appurtenances where shown on the drawings and specified hereinafter under applicable sections of this specification.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
1. Section 230713 - Duct Insulation
2. Section 230716 - HVAC Equipment Insulation

1.3 QUALITY ASSURANCE:

A. Flame and Smoke Spread Ratings:
1. All insulation materials must have a maximum 25/50 flame/smoke rating as tested by ASTM E-84, NFPA 255 and UL 723 except where specifically noted otherwise.
2. Flame/smoke rating shall be a minimum of 25/250 in equipment rooms where the room is not used as a plenum.
3. Flame/smoke rating shall be a minimum of 25/250 in tunnels, crawl spaces, and outdoors.

B. Insulation thickness shall equal those recommended by ASHRAE 90.1 or as scheduled, whichever is greater. Surface temperatures shall be below 140 degrees F.

C. Accessories such as adhesives, mastics, cements, and tapes for fittings shall have the same component rating as listed above.

D. All products or their shipping cartons shall bear a label indicating that flame and smoke ratings do not exceed requirements. Treatment of jackets or facing to impart flame and smoke safety shall be permanent. The use of water soluble treatments is prohibited.

E. Installation and materials shall meet the requirements of the International Building Codes.

F. All insulation work shall be applied by mechanics normally employed in the trade. All insulation shall be installed in accordance with the manufacturer's recommendations.

G. All insulation furnished under this Division of the specifications shall be the product of one manufacturer except for special applications.

H. Manufacturers:
1. The following manufacturers of sealants, adhesives, and mastics shall be:
a. Foster
b. Childers
c. Mon-Eco

PART 2 – PRODUCTS

2.1 MASTICS, SEALANTS, AND ADHESIVES:

A. General:
1. Materials shall be as recommended by the insulation manufacturer.
2. Products shall be applied as recommended by the manufacturer for that specific application.
3. The number of coats and thicknesses shall meet or exceed the manufacturer’s recommendation or as indicated in these specifications or on the plans, whichever is greatest (coats and thickness).
4. Materials shall meet LEED requirements for low emitting products.

B. Finish:
1. When material is applied where it is to be painted, the material shall be coated, if necessary, to allow the material to be properly painted without use of special paints or primers.

PART 3 - EXECUTION

3.1 GENERAL:

A. All insulation materials shall be delivered and stored in manufacturer's container and kept free from dirt, water, chemical and mechanical damage.

B. Insulation shall be applied by experienced workmen in a workmanlike manner.

C. Insulation shall not be applied until all pressure testing has been completed, inspected and released for insulation application.

D. Surfaces to be insulated shall be clean and dry.

E. All insulation joints shall be butted firmly together and all jackets and tapes shall be smoothly and securely installed.

F. Insulation shall be run continuously through walls, ceiling openings, and sleeves except where fire stop or firesafing materials are required.

G. Items that are factory insulated shall not receive additional insulation where not otherwise specified.

3.2 INSTALLATION:

A. General:
1. Insulation on cold surfaces where vapor barrier jackets are used shall be applied with a continuous, unbroken vapor seal.
2. Insulation on equipment that must be opened periodically for inspection, cleaning, and repair must be constructed so insulation can be removed and replaced without damage.

END OF SECTION 230700

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of insulation required for thermal and acoustical installation on all sheet metal duct and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
1. Section 23 0700 - HVAC Insulation

1.3 QUALITY ASSURANCE:

A. Codes and Standards:
1. Federal Specification HH-I-558C Mineral Fiber Boards, Blankets and Pipe Covering
2. ASTM C553 Standard Specification for Mineral Fiber Blanket Insulation for Commercial and Industrial Applications
3. ASTM C547 Standard Specification for Mineral Fiber Performed Pipe Insulation
4. ASTM G12 Standard Specification, Mineral Fiber Block and Board Thermal Insulation
5. ASTM C1136 Barrier Material, Vapor (Jacket Only)
6. ASTM C916 Liner Adhesive
7. ASTM G21, G22 Fungi and Bacteria Resistant Tests
8. ASTM C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
9. UL 723 Duct Tape

B. Duct wrap shall not exceed 25% compression.

C. Manufacturers:
1. The following fiberglass duct insulation manufacturers are acceptable.
a. Owens/Corning
b. Certainteed
c. Knauf
d. Johns Manville

PART 2 - PRODUCTS

2.1 GENERAL:

A. Duct insulation shall comply with the requirements of International Energy Conservation Code or these specifications, whichever is greater.

B. If no other specific direction is provided, the spaces for duct insulation are defined as follows:
   1. Concealed:
      a. Above ceiling.
      b. In mezzanines.
      c. In mechanical rooms.
      d. Other spaces not generally considered regularly occupied spaces.
   2. Exposed:
      a. Indoor locations generally considered regularly occupied spaces and where duct can be visible to occupants.
   3. Outdoor:
      a. Exposed to ambient conditions including sunlight and weather.
   4. Unconditioned spaces:
      a. Exposed to ambient temperatures but not to sunlight and weather. Typical spaces may be attics, crawl spaces, utility tunnels, chases open to the exterior, etc.
   5. Return air plenum:
      a. A space is only considered a return air plenum if the unducted air returning from a space or above the ceiling of the space is from the same air handler supplying that space.

2.2 TYPES OF FIBERGLASS INSULATION:

A. Fiberglass Duct Wrap:
   1. Blanket type insulation composed of glass fibers bonded with a thermosetting resin and faced with an FSK vapor retarder. The facing shall be a glass scrim reinforced laminate of aluminum foil and kraft paper bonded with a fire retardant adhesive.
   2. Insulation shall be 1.0 lb./CF density, .28K @ 75 degrees F and a facing vapor transmission of .02 perms max.
   3. Basis of design insulation shall be:
      a. Owens Corning Type 100

2.3 MINIMUM THERMAL VALUES REQUIRED FOR INSULATION (UP TO 9000 CDD50 AND UP TO 9000 HDD 65, CLIMATE ZONE 3):

A. General:
   1. This section is intended to indicate minimum as installed "R" values.
   2. Where specific duct insulation thicknesses are indicated elsewhere in this specification or on the plans, the greater thickness or insulating value shall be provided.
   3. If no other requirements are indicated and an R-0 is indicated, no insulation is required.

B. Supply Duct:
   1. Outdoor: R-6 as installed
   2. Unconditioned Space: R-6 as installed
   3. Exposed: R-6 as installed

4. Concealed: R-6 as installed

C. Return Duct:
1. Outdoor: R-6 as installed
2. Unconditioned Space: R-6 as installed
3. Exposed: R-6 as installed
4. Concealed: R-6 as installed
5. Return Air Plenum: R-0

2.4 APPLICATION OF FIBERGLASS DUCT WRAP:

A. Fiberglass duct wrap shall be provided for all ducts and plenums required to be insulated in the following locations except where dual wall duct specified, elastomeric insulation or another type insulation required, or duct specified to be uninsulated:
1. Concealed ducts
2. Exposed ducts in mechanical and utility rooms
3. Exposed ducts in occupied spaces

2.5 TAPE FOR FIBERGLASS DUCT INSULATION:

A. Tape shall be pressure sensitive joint sealing tape specifically made for the specific application in which it is used.

B. Tape shall be 3" wide minimum and shall match the insulation finish.

PART 3 - EXECUTION

3.1 INSTALLATION OF FIBERGLASS INSULATION:

A. Fiberglass Duct Wrap Insulation:
1. Duct wrap insulation seams shall be stapled 6" on center with outward clinching staples. All seams are to be sealed with pressure sensitive tape matching the facing.
2. Where rectangular ducts are 24" in width or greater, duct wrap insulation shall be additionally secured to the bottom of the duct with mechanical fasteners such as pins and speed clip washers, spaced 18" on center (max.) to prevent sagging of insulation.

B. Tape and Mastic Installation:
1. After the pressure sensitive tape is applied, a coat of mastic shall be applied to the tape overlapping the insulation by 2" minimum.
2. Tape and mastic shall also be applied to all tears, rips, punctures, penetrations, mechanical fasteners, access doors, and all other locations as necessary to ensure a continuous vapor tight system.
3. Mastic must also be applied to any factory applied tape such as on factory insulated supply grilles, etc.

END OF SECTION 230713

SECTION 230900 - INSTRUMENTATION AND CONTROLS FOR HVAC (GENERAL)

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
   1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of the building environmental controls shown on the drawings and specified hereinafter.

B. Description:
   1. Control and instrumentation work shall include:
      a. Temperature control
      b. Equipment interlock and controls
      c. Wiring for automatic controls

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
   1. Section 230904 - Building Automation System

1.3 QUALITY ASSURANCE:

A. Codes and Standards:
   1. All environmental controls shall comply with all local codes and ordinances, and meet or exceed the following standards:
      a. Underwriters Laboratories
      b. NEMA Standards
      c. National Electric Code
      d. Scientific Apparatus Makers Associates Standard PMC 20.1 for Process Measurement and Control Terminology
      e. Scientific Apparatus Makers Associates Standard PMC 20.2 for Process Control Performance
      f. NFPA 90A
      g. NFPA 72E Natural Fire Alarm and Signaling Code

B. Control circuit wiring shall meet NFPA Standard 70, Article 725, for remote control, low energy power, low voltage power and signal circuits.

C. All control equipment shall be the product of one manufacturer whenever practical.

D. Manufacturers:
   1. The following Building Environmental Controls Contractors are acceptable:
      a. Control Management, Columbia, South Carolina

2. The following control manufacturers are acceptable:
   a. Seimens
3. The following plastic control guard manufacturers are acceptable:
   a. STI
   b. Approved equal
4. The following needlepoint bipolar ionization manufacturers are acceptable:
   a. GPS
   b. Approved Equal

PART 2 - PRODUCTS

2.1 GENERAL:

A. The building environmental controls shall be provided by the Building Environmental Controls Contractor.

B. The Building Environmental Controls Contractor shall have a local office within a 75 mile radius of the job site, staffed with factory trained engineers. The engineers shall be capable of providing instructions and maintenance service on all system components.

C. The Building Environmental Controls Contractor shall have a 5-year successful history in the design and installation of building systems and automatic temperature controls similar in performance to that specified herein and shall be prepared to evidence this history as condition of acceptance and approval prior to bidding.

D. The Building Environmental Controls system shall be installed by competent controls mechanics who are full time employees of the Building Environmental Controls Contractor.

E. The Environmental Control Contractor shall be responsible for the quality and satisfactory operation of the devices within the system and for the overall performance of the specified air flow control system.

2.2 SYSTEM:

A. Provide all thermostats, humidistats, sensors, transmitters, controllers, actuators, control panels, conduit, wiring, accessories and appurtenances for a complete building environmental control system.

B. Provide switches, fuses, disconnects and all other devices necessary for protection and convenient operation of system.

C. The contractor shall be responsible for providing power wiring, conduit, breakers and final connections for all control devices, panels, and components unless specifically shown on electrical plans:
   1. Control devices

D. The control system shall be on normal power.

2.3 CONDUIT:

A. General:
1. All control conduit shall be furnished and installed under this division except where specifically indicated otherwise.
2. All line voltage and control wiring in new construction shall be run in conduit.
3. All control wiring in existing construction shall be (run in conduit) (run in j-hooks spaced no greater than 3 ft. oc).
4. Conduit shall be provided in accordance with the Electrical Division of this specification unless noted otherwise in these specifications.
5. Outdoor conduit shall be GRC.
6. Indoor conduit shall be EMT.
7. Conduit shall be 3/4".

B. Exposed Conduit (Indoor):
1. All exposed (in corridors and all other spaces where visible without removing ceiling tile but not in mechanical or electrical spaces) conduit shall be prepainted conduit.
2. Conduit shall be prepainted color to be selected by Owner.

2.4 CONTROLS WIRING:

A. Wiring for low voltage circuits generally shall be No. 18B and S gauge or larger RSH-2 heat resistant.

B. Cables of two or more conductors, not smaller than 22 B and S gauge if shielded or No. 18 B and S gauge if not shielded, may be used for low voltage d-c and electronic circuits carrying less than 1.50 amperes, in lieu of individual wires.

C. Cables carrying a-c circuits sensitive to external fields shall be shielded.

D. Cables having fewer than 12 conductors shall have thermoplastic or rubber insulation for 300 volts or more and a heavy outer braid or thermoplastic sheath. Shields shall be grounded to building's grounding system, using wire not smaller than No. 14 B and S gage. Shields shall not be grounded to conduit systems or building piping.

E. Cables shall terminate in solder or screw type terminal strips. All terminal strips shall be numbered.

F. Cables shall not be tapped at intermediate points.

G. All wires, whether individual or in cables, shall be color coded and numbered for identification in accordance with the National Electric Code.

H. Wire, where specifically permitted to be installed without conduit, shall be plenum rated.

2.5 TRANSFORMERS:

A. Transformers shall be furnished and installed for supplying current to control equipment as required.

B. Transformers shall conform to NEMA standards, shall be capable of supplying 125 percent the connected load, shall be enclosed in U.L. listed cabinets, ventilated, with conduit connections, and provided with fused disconnect switches on primary side and on secondary side.

2.6 CONTROL VOLTAGE:

A. Voltage shall not exceed 24V.

2.7 DDC THERMOSTATS:

A. General:
1. The electronic thermostat shall allow the following functions:
a. Temperature setpoint adjustment.
b. Override switch (from unoccupied to occupied).
2. The electronic thermostat shall allow the following to be programmed from the building control system:
a. Space occupied and unoccupied temperatures.
b. Space occupied and unoccupied times.
c. Allowable space setpoint adjustment.
d. Length of override duration.
3. The electronic thermostat shall have the following features:
a. Digital display.
4. Thermostats shall connect to unit controller via communication cable with a standard jack. The thermostat shall also have a connection available for field monitoring.
5. Devices installed in duct system shall be specifically designed for duct systems.

B. Construction:
1. Device shall be polymer construction.
2. Circuit boards shall be coated.

C. Technical Specifications:
1. Ambient Operating Conditions: 32 deg F to 140 deg F, 0 to 100% RH
2. Accuracy: ± .34 deg F @ 70 deg F (thru film nickel)

2.8 DDC HUMIDISTAT:

A. General:
1. Provide electronic humidistat without setpoint adjustment.
2. Humidistat shall connect to unit controller via communication cable with a standard jack. The humidistat shall also have a connection available for field monitoring.
3. Devices installed in duct system shall be specifically designed for duct system.
4. Where humidistat and thermostat are located adjacent to each other and both are providing input for the same piece of equipment, a combination humidity transmitter and temperature sensor may be provided at the contractor’s option.
5. The humidistat shall be a separate device from other control sensors/devices when input is not used to control one specific piece of equipment.

B. Construction:
1. Devices shall be polymer construction.
2. Circuit boards shall be coated.

C. Technical Specification (@ 77 deg F):
1. Ambient operating conditions: 32 deg F to 140 deg F, 0 to 100% RH
2. Accuracy: ± 3% RH for 20-80% RH
± 5% RH for 5-20% and 80-95% RH
3. Temperature Coefficient: .12% RH/deg F
4. Response: less than 120 sec between 50-90% RH
5. Offset Adjustment: ± 5

2.9 SENSORS, TRANSMITTERS, AND OTHER CONTROL DEVICES:

A. General:
1. Provide the type device specified for the specific application. Where the device is not specifically indicated, provide the device best suited to provide the control specified.

B. Location of device:
1. Device shall be located as indicated on the drawings or as stated in the specifications.
2. Where no device location is indicated or specified, the device shall be located as recommended by the manufacturers to provide the best practical results.
3. Where the location indicated on the drawings or stated in the specifications does not provide the best practical results, the manufacturers shall provide recommendations for relocating the device.
4. It shall be the responsibility of the contractor to identify all conflicts between indicated device locations and manufacturers recommended locations prior to installation of any related components (i.e., sensor wells, conduit, etc.).

2.10 SAFETY DEVICES:

A. General:
1. Safety devices including, but not limited to, the following shall be hard wired to perform their required function. Status, where specified, shall be monitored by the building automation controls system and initiate other sequences where required:
a. Condensate overflow switch
b. Smoke alarm, via unit duct detector, where shutdown sequence is specified to be by mechanical.

2.11 CONTROL PANELS:

A. General:
1. All controllers, relays, switches, etc., for equipment shall be mounted in enclosed control panels with key lockable, piano hinged door.
2. Location of each panel shall be where indicated on plans, approved by A/E, and convenient for adjustment and service.
3. Label each panel properly identifying function or service of panel and all surface mounted devices.

4. Control panels shall be extruded or formed, cold-rolled steel, enamel surfaced, with full length mounting brackets, drilled wall mounting holes.
5. The control panel shall be key lockable.
6. Provide a 24V control transformer.

2.12 FLOAT SWITCH:

A. General:
1. Float switch shall include a sealed, waterproof reed/magnet float switch with no exposed electrical contacts.
2. Float shall be prewired with 6 ft. long, 18 ga. lead cables.
3. Switch shall be tested to UL 508 and UL listed for 24V AC.
4. Float shall attach to drain pan with stainless steel clips.

B. Locations:
1. All drain pans.

C. Basis of design manufacturers shall be:
1. SMD Research Safe-T-Switch Model SS3.

2.13 EQUIPMENT STATUS:

A. Equipment status shall be provided by solid state current sensors.

B. Sensor shall have non-polarity sensitive outputs, trip point adjustment, trip LED, and power LED.

2.14 BIPOLAR IONIZATION:

A. General:
1. The electrodes shall be needlepoint type. Needlepoints shall not protrude into the airstream.
2. The bipolar ionization system shall be capable of:
a. Effectively killing microorganisms downstream of the bipolar ionization equipment (mold, bacteria, virus, etc.).
b. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.
c. Reducing space static charges.
d. Reducing space particle counts.
3. The bipolar ionization system shall produce equal amounts of positive and negative ions.
4. Relative humidity from 0 – 100%, condensing, shall not cause damage, deterioration, or dangerous conditions to the air purification system.
5. Bipolar ionization units shall be tested and listed by either UL or ETL according to UL Standard 2998.
6. The operation of the electrodes or bipolar ionization units shall conform to UL 2998 with respect to ozone generation.

B. Electrodes:
1. Each plasma generator shall include the required number of electrodes and power generators sized to the air handling equipment capacity.

2. Ionization output from each electrode shall be a minimum of 5 million ions/cc when tested at 2" from the ion generator.

C. Air Handler Mounted Units:
1. The entire cooling coil shall have equal and adequate ionization distribution across the face of the coil.
2. Ion generators shall be mounted in a linear configuration to minimize space required. The ion generators and mounting bar shall be 4" deep or less.
3. The power supply shall accept the following voltages: 12V DC; 24V AC; 120V AC; or 230V AC. Power from the power supply to the ionization generators shall be 12V DC.

D. Electrical:
1. Generators shall include internal short circuit protection, overload protection, and automatic fault reset.
2. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
3. The power supply shall have an On/Off switch and power indicator LED.

E. Control:
1. Generators shall include an external control interface to monitor generator status and alarm.

F. Control (Air Handler Mounted Units):
1. The system shall be provided with a standalone ion sensor to monitor ion output.
2. The ion sensor shall measure real time density of ions/CM^3.
3. Sensors shall be designed to be mounted anywhere in the system downstream of the ion generator.
4. Sensor shall include an external control interface to monitor proper ion generation.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General:
1. The Building Environmental Controls Contractor shall be responsible for a complete operational system.
2. The installation shall include:
   a. Drawings
   b. Supervision
   c. Interlocks
   d. Adjustments
   e. Verification
3. Location of sensing elements shall be the responsibility of the installer.

B. Wiring splices shall not be permitted in electrical panelboards, junction boxes and switchgear.

3.2 THERMOSTATS, HUMIDISTATS AND SWITCHES:

A. General:
1. Install all devices as recommended by manufacturer.
2. When device is provided by the control contractor, the control contractor shall be totally responsible for all coordination with the equipment supplier to ensure compatibility of components to meet the requirements of the equipment manufacturer and the control sequence.

B. Installation:
1. Mount thermostats, sensors, and switches 4'-0" above finished floor to the top of the device's control mechanism unless noted otherwise.
2. Mount humidity sensors 7'-0" above finished floor unless noted otherwise or when a combination temperature and humidity sensor is permitted.
3. Thermostats mounted on exterior walls shall be mounted on a thermally insulated sub-base.
4. When location is not shown, Contractor shall assume the most remote location served by unit. Coordinate exact location with A/E.
5. Contractor shall coordinate location of thermostat, humidistats, and switches with final architectural plans and actual field conditions to avoid locating them inside cabinets, bookcases, casework, chalkboards, tackboards and behind door swings and similar obstructions that would limit access or limit the ability to properly sense space conditions.

3.3 WIRING:

A. All control wiring within starters (and motor control centers) shall be installed in a workmanlike manner and neatly laced.

B. All wiring installed in manholes, below grade, or below ground water level shall be made up with waterproof connections.

C. Wiring in manholes shall be continuous thru manholes.

3.4 CONDUIT:

A. Conduit sleeves thru non-waterproofed walls and floors shall be grouted and caulked on both sides of wall.

B. After installation, any painted pipe which is damaged shall be touch-up painted.

3.5 EXISTING CONSTRUCTION:

A. Control wiring and conduit shall be installed in existing walls, slabs, and ceilings.

B. Where conditions do not permit installation of conduit and wiring in existing walls, slabs, and ceiling; and, when approved by the engineer, wire mold and similar finished enclosures may be provided.

C. Conduit and wiring shall be installed above existing ceilings except where removal of existing ceilings is specifically identified in other dimensions of work (if any). The

Contractor shall be responsible for removal of all other existing tile/grid and replacement of the tile/grid as necessary. Any damaged tile/grid shall be replaced by the Contractor at the Contractor's expense.

3.6 DEVICES ON EXTERNALLY INSULATED DUCTS:

A. Devices mounted on externally insulated ducts shall be mounted on standoff brackets to allow proper installation of duct. If device must be mounted directly to duct for proper operation, standoff bracket may be deleted.

3.7 FLOAT SWITCH:

A. Secure bracket to drain pan with screw.

B. Verify float is properly positioned.

3.8 BIPOLAR IONIZATION:

A. Calculations:
1. Provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1 (latest edition) to validate acceptable indoor air quality at the quantity of outside air scheduled.

B. Submittals:
1. Air handler bipolar ionization generator submittals shall include dimensional drawings showing the units in which the generators are to be installed. The submittal shall include documentation stating that the installation requirements have been coordinated with the air handler manufacturer.

C. Installation (Air Handler Bipolar Ionization Generators):
1. Air handler bipolar ionization generators shall be factory or field installed. If field installed, installation shall be in strict accordance with manufacturer’s written recommendations.
2. The ionization generators shall be wired to the remote mounted power supply.
3. Install ion sensor in duct system where accessible for servicing.

END OF SECTION 230900

SECTION 230904 - BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of the building automation system shown on the drawings and specified hereinafter.

B. Description:
1. The work shall include, but not be limited to, the following:
   a. Field programmable digital system controller(s).
   b. Digital transmission system.
   c. Field programming to perform monitoring and control functions specified herein and on point schedule.
2. All sensors, actuators, transducers, solenoids, transformers, wiring and appurtenances shall be provided for a complete building automation system.
3. Digital controller shall include the distributed microprocessors.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
1. Section 230900 - Instrumentation and Control for HVAC (General)

1.3 QUALITY ASSURANCE:

A. Codes and Standards:
1. All equipment and components shall comply with all local codes and ordinances, and meet or exceed the following standards:
   a. American Society for Testing and Materials ASTM
   b. Institute of Electrical and Electronic Engineers IEEE
   c. National Electrical Manufacturers Association NEMA
   d. Underwriters Laboratory, UL (UL 916)
   e. FCC Regulation, Part 15, Section 156
   f. National Fire Protection Association NFPA

B. All the equipment shall have the UL label.

C. Manufacturers shall be:
1. Siemens

PART 2 - PRODUCTS

2.1 GENERAL:

A. The control system shall consist of high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Operators shall be able to perform all normal operator functions through the web browser interface including downloading memory, parameters, and schedules to any module. The system shall be capable of interfacing with Wireless Access Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA).

B. The system shall support Wb services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher.

C. The system shall be capable of future expansion to include monitoring of occupant card access, fire alarm, lighting control systems, cameras and security systems.

D. The control algorithm shall be proportional and integral. Derivative functions are required where stability of the controller is not likely with PI algorithms.

E. A control panel used to control equipment on a floor shall typically not be used to control equipment on any other floor (i.e. Panel for terminal units for first floor terminal units shall not be used to control second floor terminal units).

2.2 BacNet COMMUNICATION PROTOCOL:

A. The system shall use the BacNet protocol for communication to the operator workstation or web server and for communication between control modules. Schedules, setpoints, trends, and alarms shall be BacNet objects and shall conform to ANSI/ASHRAE Standard 135-2004, BacNet.

2.3 DIGITAL CONTROLLER COMPONENTS:

A. General:
   1. Each controller shall consist of the following:
      a. Enclosure with keyed hinged door and mounting brackets
      b. Power assembly
      c. System microprocessors
      d. Communications board
      e. Field termination board

B. Power Assembly:
   1. The power assembly shall consist of :
      a. Transformer
      b. Filter to eliminate transients
      c. Power regulator/surge suppresser
      d. Battery charging circuit
      e. Battery with 24 hour backup for RAM

C. Display:
1. The digital display shall be programmed to display analog variables, binary conditions, off normal scans and other analog and binary information required for analysis and adjustment of the system being controlled.

2.4 COMMUNICATIONS:

A. General:
1. All digital devices shall be assigned a numeric address.
2. Communications, commands and responses shall be digital.
3. Communications hardware shall include all encryption, filtering, amplifications diagnostics and error lodging.
4. Provide surge suppresser.

2.5 DIGITAL CONTROLLER CAPABILITIES:

A. Field Programmable:
1. The controller shall contain all necessary mathematics, logic, utility functions and all standard energy calculations and control functions in ROM to be available in any combination for field programming the unit. These routines shall include but not be limited to:
a. Math routines:
1) Basic arithmetic
2) Binary logic
3) Relational logic
4) Fixed formulas for psychrometric calculations
b. Utility routines for:
1) Process entry and exit
2) Keyboard functions
3) Variable adjustments and output
4) Alarm indication
c. Control routines for:
1) Signal compensation
2) Loop control
3) Energy conservation
4) Timed programming
2. Final field programs shall be stored in battery backed up RAM.

B. Calibration Compensation:
1. The digital controller shall sense the voltage being supplied to the resistance sensing element and through firmware and shall compensate for power supply changes due to ambient temperature changes at the power supply.

C. Diagnostics:
1. The digital controller shall continuously perform self diagnostics. All malfunction shall alarm the front end system.

D. Default Operating Procedure and Alarms:
1. All variables shall be identified as being reliable or unreliable. When a calculation is required to use a value (sensed or calculated), which is identified as being unreliable, the unreliable data value will flash. The calculation will use a default value programmed into the unit.

2. All alarms shall be indicated at the digital controller and at the front end system.

E. Energy Management Functions:
1. The controller shall be capable of performing the following energy management functions:
   a. Time of day scheduling
   b. Start/Stop optimization
   c. Peak demand limiting
   d. Duty cycling (temperature compensated)
   e. Economizer control
   f. Enthalpy changeover
   g. Chilled water reset
   h. Hot water reset
   i. Occupied/Unoccupied mode
   j. Chiller optimization

F. User Specified Programs:
1. The controller shall be capable of generating programs specified by the user including:
   a. Intermediate season control (dead zone)
   b. Trending of variables
   c. Historical data storage
   d. Totalizing
   e. Holiday and event programming

G. Control Loop Compensation:
1. Control loop compensation shall include:
   a. Hysteresis correction
   b. Limited control output
   c. Ramp output
   d. Anti-reset windup

H. Access Levels:
1. The controller shall have a minimum of three levels of passwords as follows:
   a. Level One - Read all setpoints
   b. Level two - Program occupied periods
   c. Level Three - Program all setpoints and programs

2.6 GRAPHICS:

A. Graphics shall operate thru the microprocessor and shall be dynamic and animated.

B. The graphic software shall display and update current control point data.

C. Notification of alarms from the panels must be provided on the graphic display while the system is in graphics mode.

D. A library of HVAC symbols shall be provided for use in generating custom displays. The graphic symbols shall include fans, pumps, valves, chillers, air handlers, cooling towers, rooftop units and boilers.

E. The graphic display shall indicate alarm conditions for each air handling unit.

F. The graphic display shall display a global graphic for each building which shall include status of air handling units, smoke exhaust fans, exhaust fans, dampers and alarm conditions.

G. Fireman's Smoke Control Panel (FSCP) graphics and points to be displayed at the control operator's terminal in a similar graphic layout as on the FSCP face.

H. The following graphics shall be generated and installed under the contract:
1. Site location
2. Building sites
3. Floor plan
4. Equipment rooms
5. Each heating and cooling unit
6. Each exhaust fan
7. Ambient conditions

2.7 SURGE PROTECTION:

A. Surge suppression shall be provided on communications lines and power sources at each control panel.

B. Surge suppression shall be type recommended by manufacturer to provide maximum protection of system components.

2.8 OWNERS WITH EXISTING BUILDING AUTOMATION SYSTEMS:

A. When this facility is brought on-line, the existing software and hardware shall be upgraded as necessary to support the graphics, sequences and other functions of the building automation system.

B. The data, information and graphical representations of the systems at this facility shall be equal to or greater than that installed for other facilities (in the District) or as indicated in these specifications, whichever is greater.

2.9 BACK-UP POWER:

A. Provide a UPS for all panels in this specification.

2.10 SETPOINT CHANGES:

A. Setpoints shall be changed on function blocks. User must also be able to change setpoints without having to go to the function blocks. Acceptable methods include changing setpoints on a “Properties Page” or on the system graphics.

PART 3 - EXECUTION

3.1 OPERATION:

A. Upon restoration of power, equipment shall be sequentially started and shall at no time exceed last demand limit setting.

3.2 EXISTING EQUIPMENT:

A. The tags (name) of existing equipment have been changed to be consistent with other District projects. See the existing equipment schedules.

END OF SECTION 230904

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS AND POINTS LIST

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of controls system shown on the drawings and specified hereinafter.

B. Description:
1. Points shown for equipment shall be for each item of equipment except:
   a. When noted otherwise.
   b. When exhaust fans are grouped together.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
1. Section 230900 - Instrumentation and Control for HVAC (General)
2. Section 230993.6 - Sequence of Operation (Single Zone Packaged Equipment)

PART 2 - SEQUENCE OF OPERATION

2.1 GENERAL:

A. These sequence descriptions and definitions shall apply to all sequences unless sequence specifically indicates otherwise.

2.2 SETPOINTS:

A. In general, the specification indicates setpoints or range of setpoints for most devices.

B. Temperatures shall be field settable to any temperature.

C. Time of day operations shall be field settable to any time.

D. The contractor shall adjust setpoints in the following manner:
1. As required to start-up, test, debug and otherwise ensure equipment and system is operating as intended.
2. Dampers, actuators, and similar devices should be left in their optimum operating position.

3. Thermostats, humidistats, and similar devices should be left as indicated on drawings or in specifications. If no value is indicated, contractor should set at a reasonable value.
4. Equipment and system schedules should be reviewed with the Owner and A/E prior to initiating the schedule.

2.3 MORNING WARM-UP/COOL-DOWN:

A. This mode is the mode between night setback and normally occupied mode and is used to bring area served from unoccupied conditions to conditions required for occupancy.

B. This mode typically will operate with outside air systems closed or de-energized.

C. The start time of this mode shall be determined by the building automation system based upon space temperatures, building characteristics, outside temperature, and historical ability of each system to warm up or cool down the building.

2.4 NIGHT SETBACK:

A. This mode is the unoccupied mode.

B. This mode is a timed function of adjustable duration.

C. This mode typically will operate with outside air systems closed or de-energized and is used primarily to maintain unoccupied space temperature (adjustable) or space humidity level (adjustable).

D. All HVAC equipment required to maintain space conditions shall be energized in this mode.

2.5 OVERRIDE:

A. When override is activated, the system shall operate with that zone, equipment, or system in the occupied mode.

B. At the end of the override time period, the zone equipment or system shall return to the mode scheduled at that time.

2.6 OUTSIDE AIR CONTROL:

A. Where motorized dampers are specified, the dampers shall open to maintain the airflow quantity indicated on the equipment schedule.

2.7 FAILURE MODES:

A. General:
1. Initiating devices shall each be hard wired.
2. Manual reset of temperature alarm and pressure alarm shall be required. Other alarms shall automatically reset unless manual reset indicated.

B. Smoke and Fire Alarm:
1. The fans shall be de-energized and smoke dampers shall shut. The fan shall de-energize as fast as practical and smoke dampers shall begin closing after fan is de-energized.

C. High Condensate Level:
1. Upon a rise in condensate level in the condensate pan, the float switch shall de-energize the unit.

2.8 SYSTEM OPTIMUM START:

A. The building automation control system shall provide an optimum start sequence for the HVAC system.

B. Optimization shall be determined by a comparison of indoor and outdoor environmental conditions and system capacities.

C. At the completion of optimum start, the building shall be at design temperatures. This is not necessarily, and in most cases will not be, the same time as the start of the occupied period. For example, the completion of optimum start could be set at 7 am and the occupied mode set at 9 am. The occupied mode is typically when ventilation air would be energized.

2.9 ALARMS:

A. In addition to the alarms indicated, all temperatures and other monitored or sensed conditions that fall above or below the normal range shall be alarmed.

B. Alarms shall be assigned a level of alarm (minimum three levels - low (maintenance), high (important), and critical).

2.10 REMOTE NOTIFICATION:

A. Critical alarms shall be sent via text and/or email to up to six (6) Owner identified recipients.

PART 3 - POINT SCHEDULE

3.1 DEFINITION OF POINTS:

A. Binary Output:

1.	Control Relay	- Energize/de-energize
2.	Hand/Off/Auto	- Starter

B. Analog Output:

1.	Cooling	- Control Valve
2.	Heating	- Control Valve SCR Heater
3.	Humidification	- Control Valve

4.	Economizer	- Dampers
5.	Position Adjust	- Fan Drives Dampers

C. Binary Input:

1.	Differential Pressure	- Fan Status Pump Status
2.	Pressure Switch	- Pressure
3.	Flow Switch	- Fan Status Pump Status
4.	Fire/Smoke	- Smoke Detector Fire Sensor
5.	Freeze	- Low Limit
6.	Filter	- Filter Pressure
7.	Setback Override	- Night Setback Override

D. Analog Input:

1.	Humidity	- Humidity
2.	Temperature	- Temperature
3.	Static Pressure	- Static Pressure
4.	Fan Speed/Load	- Fan Drives
5.	Air Flow	- Air Flow

SYSTEM POINT SCHEDULE

POINT SCHEDULE NO. 1

SYSTEM
--

SPACES SERVED
--
--
--

HARDWARE

POINT DESCRIPTION	OUTPUT FROM BACS							
	BINARY			ANALOG				
	CONTROL RELAY			COOLING	HEATING	DEHUMIDIFICATION		
Outside								
EF-#	●							
WMHP-#	●			●	●	●		

POINT DESCRIPTION	INPUT TO BACS																										
	BINARY					ANALOG																					
	CURRENT SENSOR	FILTER				OUTSIDE HUMIDITY	OUTSIDE TEMP	SPACE HUMIDITY	SPACE TEMPERATURE																		
Outside						●	●																				
EF-#	●																										
WMHP-#	●	●						●	●																		

SOFTWARE

POINT DESCRIPTION	ALARMS										
	BINARY							ANALOG			
	FILTER	ALARM						HIGH TEMPERATURE	LOW TEMPERATURE	RUN TIME	HIGH HUMIDITY
Outside											
EF-#										●	
WMHP-#	●	●						●	●	●	●

POINT DESCRIPTION	APPLICATION PROGRAMS								
	SCHEDULED START/STOP	S/W CHANGEOVER	DAY/NIGHT SETBACK						
Outside									
EF-#	●								
WMHP-#	●	●	●						

Failure Modes
○ -- ON
● -- OFF
L -- Last

END OF SECTION 230993

SECTION 239005.1 - HEAT TRANSFER (ELECTRIC COOLING, WALL MOUNTED UNITS)

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
   1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of wall mounted units and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:
   1. All work shall meet or exceed the standards and procedures of the following as referenced (latest editions):
      a. ARI Standards 390
      b. ANSI Z21.47/UL - Unitary Air Conditioning Standard for Safety Requirements
      c. Underwriter's Laboratory
      d. NFPA 90A
      e. AMCA 210 Test Code For Air Moving Devices
      f. National Electric Code
      g. ASHRAE 15 - Safety Code for Mechanical Refrigeration

B. All motors and equipment shall be U.L. labeled.

C. All insulation and materials shall have a flame spread rating of less than 25 and smoke developed of less than 50.

D. All heating and cooling equipment shall bear the ARI seal.

E. All coils shall be ARI certified.

F. All electric heaters shall have impedance protection per UL519.

G. Manufacturers:
   1. The following exterior wall mounted heating and cooling unit manufacturers are acceptable:
      a. Bard
      b. Marvair
      c. Approved Equal

PART 2 - PRODUCTS

2.1 GENERAL:

A. General:
1. Equipment shall meet or exceed the scheduled efficiencies or ASHRAE 90.1, whichever is greater.
2. Furnish and install heating and cooling units in accordance with the drawings and as specified hereinafter.
3. Units shall be air conditioning or heat pump as shown on equipment schedules.
4. Unit shall be factory assembled and tested.
5. Standard operating range for cooling shall be 55°F to 120°F outdoor ambient except where low ambient controls are required.
6. Refrigerant shall be R410A.

B. Construction:
1. The cabinet shall be fabricated of not less than 20 gauge steel.
2. The unit shall be thermally and acoustically treated to ensure quiet operation.
3. The cabinet and all exposed components shall be finished with a baked enamel paint.
4. Sheet metal parts shall have a combination of factory applied corrosion resistant baked enamel and polyurethane coating.
5. All finishes shall be factory applied.
6. The condenser fan and motor assembly shall slide out.

C. Refrigerant Circuits:
1. All units shall have factory installed thermal expansion valve, liquid line filter dryer, liquid line sight glass, pressure tap ports, check valves, and suction and liquid service valves.
2. Heat pump units shall also have reversing valve and suction line accumulator.
3. Where low ambient control is required, electronic head pressure control shall be provided.

D. Compressors:
1. Compressor shall have centrifugal oil pump.
2. Motor shall have internal temperature and current sensing motor.
3. Compressor shall have totally dipped hermetic motor windings.
4. Compressor shall be resiliently mounted and seismically isolated.
5. Sound attenuation jacket on all compressors except single stage exterior units.

E. Outdoor Coil:
1. The outdoor coil shall be constructed of aluminum spine fin mechanical bonded to seamless aluminum or copper tubing with all joints brazed.
2. Surface shall be engineered to facilitate defrost water runoff.

F. Indoor Coil:
1. Indoor coils shall be constructed of aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed.
2. Coil shall include factory installed refrigerant metering device and refrigerant line fittings.
3. Coating shall have coating to reduce mold growth.

G. Outdoor Fans and Motors:
1. Direct drive fan motors shall be permanently lubricated, weatherproof motors suitable for outdoor use.
2. Motor shall have built-in current and thermal overload protection.
3. Fans shall be resiliently mounted and seismically isolated.
4. Fans shall be statically and dynamically balanced.
5. Provide PVC coated fan guard.
6. ECM or PSC blower motor.

H. Indoor Fan and Motors:
1. Fan shall be forward curved, double inlet type. Fan shall be statically and dynamically balanced and shall run on permanently lubricated bearings.
2. Direct driven fan motor shall be ECM, multi-speed, permanently factory lubricated.
3. Motor shall have built-in current and thermal overload protection.
4. Fans shall be resiliently mounted and seismically isolated.
5. Fans shall be statically and dynamically balanced.
6. Fan-motor assembly shall slide out for service.
7. Motors shall be premium efficiency.

I. Safeties
1. Heat pumps shall have a solid state defrost control. Defrost shall occur only when coil saturated suction temperature indicates freezing temperatures. The defrost timer shall be thirty (30) minutes minimum. After the timer expires, if the outdoor coil does not reach setpoint within ten (10) minutes, defrost shall terminate.
2. Provide a time-guard device to prevent compressor recycling by requiring a 5-minute delay before restarting.
3. Auto reset high and low pressure switches.
4. Phase loss protection.
5. Phase rotation monitoring.

J. Electric Heaters:
1. Heaters shall have a total output as scheduled on drawings.
2. Each heater assembly shall include power supply fusing if over 48 amps, automatic resetting limit switches and heat limiters for thermal protection.
3. Heaters shall be provided with polarized plug for quick connection to unit low voltage wiring.
4. Electric heaters factory furnished and installed capacity not to exceed scheduled capacity at rated voltage.
5. If heaters larger than specified are supplied, they shall not be large enough to require larger supply wiring or panelboard breakers.

K. Refrigerant Circuit (Units with Hot Gas Reheat):
1. Reheat coils shall have three-way valves.
2. Provide On/Off control of hot gas reheat.
3. Discharge air temperature shall be adjustable from the building automation control system where modulating reheat is provided.
4. A factory or field installed freezestat shall be provided to prevent the evaporator from icing.

L. Drain Pan:
1. Provide dual slope insulated non corrosive drain pan.

2. Drain pan shall be galvanized with a baked on polyester enamel coating or molded plastic.

M. Filters:
1. Provide flat filter rack to accommodate both a 1 inch or 2 inch filter.

N. Electrical:
1. All units, other than 460/3 units, shall have circuit breaker.
2. 460/3 Units shall have non fused disconnect switches.
3. Power wiring shall be fused.
4. Start capacitor kit (single phase units)
5. Crankcase heater

O. Controls:
1. The unit's heating, cooling, dehumidification, and outside air damper or fan shall be controlled by the building automation control system.
2. The unit's control module shall communicate with the building automation system.

P. Accessories:
1. Factory or field installed needlepoint bipolar ionization.

2.2 OUTDOOR WALL MOUNTED UNITS:

A. General:
1. Unit shall be designed to be mounted on an exterior wall with all service access from exterior.
2. The cabinet color shall be selected by architect.

B. Construction:
1. All portions of the unit in contact with indoor air shall have 1" foil faced, rigid insulation.
2. The unit shall have full length vertical and bottom mounting brackets.
3. A rain hood with flashing shall be provided.
4. The top of the unit shall be sloped.
5. Side portion of cabinet shall be removable for full access to electrical. The circuit breaker or disconnect shall be in a hinged lockable enclosure.

C. Wall sleeve:
1. Insulated wall sleeves shall be provided for the supply and return wall openings.

D. Refrigerant System:
1. Two stage scroll compressor.

E. Indoor grilles:
1. Grilles shall be painted extruded aluminum. Finish shall be white.
2. Supply grille shall have adjustable blades with opposed blade damper.

F. Outside Air:
1. Outside air shall be provided by motorized dampers.

G. Electrical:
1. Unit shall have a single point power connection.
2. Provide factory installed fuses in the power wiring.

H. Sound Levels:
1. The unit shall not exceed a sound pressure level of 55 dBA measured 5 feet from the return grille and three feet above the floor.
2. Measurements shall be based upon a unit with an unducted supply and a room with hard surfaces (i.e. no acoustical treatments).

2.3 SEACOAST CONSTRUCTION:

A. The following units shall be provided with seacoast construction:
1. WMHP-1, 2, 3, 4

B. Provide coatings on the evaporator and condenser coil greater than or equal to 10,000 hours when tested per ASTM B-117.

C. Provide cabinet coatings on the internal and external cabinet components including blower assembly, drain pan, brackets, doors, panels, top and condenser section. Min resistance of 6,000 hours when tested per ASTM B-117.

PART 3 - EXECUTION

3.1 SUBMITTALS:

A. Provide dimensional drawings indicating electrical rough-in locations and drain rough-in locations for all floor mounted and wall mounted equipment.

B. Provide dimensional drawings indicating height above finished floor of all wall sleeves. Dimensions should include thickness of walls in which sleeves are to be installed.

C. Field verify thickness of walls in which sleeves are to be installed at the location of each sleeve.

3.2 CONDENSATE DRAIN LINES:

A. Provide a weather seal grommet where drain penetrates casing and wall sleeve.

3.3 WALL SLEEVES:

A. Provide insulation around entire wall sleeve.

B. Caulk wall sleeve all around to form an air and water tight seal at wall.

C. Provide all gasketing and sealants recommended by the manufacturer.

3.4 WALL MOUNTED UNITS:

A. Upon completion of installation of the units, the manufacturer's service technician shall do a complete check, test, and start-up on each unit.

B. Provide a report to the A/E with the following data on heating, cooling, and dehumidification cycles: amps, suction pressure, discharge pressure, return air temperature, coil leaving air temperature, and supply air temperature.

3.5 WARRANTY:

A. When a compressor fails within the warranty period, the compressor shall be replaced.

B. If the system had dual compressors on a single refrigerant circuit, and one compressor fails, both compressors shall be replaced during the warranty period.

3.6 EXISTING FACILITIES:

A. Where units are shown to be installed in existing buildings, existing conditions such as wall thickness, ceiling type and elevation, and other existing conditions which could affect the new unit installation shall be field verified before ordering equipment.

B. Where units are shown to replace existing units, existing conditions such as wall thickness, sleeve locations, ceiling type and elevation, electrical power, louver sizes, and other existing conditions which could affect the new unit installation shall be field verified before ordering equipment.

C. All existing conditions impacting or preventing the installation of new equipment shall be documented and submitted to the engineer and issues resolved before ordering equipment.

END OF SECTION 239005.1

SECTION 260500 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL CONDITIONS

1.1 WORK INCLUDED:

A. The work covered under these sections of the specifications consists of furnishing labor, equipment, supplies and materials, and of performing operations, including cutting, channeling, chasing, excavating and backfilling necessary for the installation of wiring systems, raceways, wiring, and electrical equipment in accordance with this section of the specifications and the accompanying drawings.

B. The Electrical Work shall include, but not be limited to, the following:
   1. Raceway systems
   2. Conductors and cables
   3. Wiring devices

1.2 RELATED WORK:

A. Related work to Division 26:
   1. Division 1
   2. The provisions, conditions, and requirements preceding and including general and supplemental conditions apply to and are a part of Divisions 26, 27 and 28.

1.3 DEFINITIONS:

A. Provide: Furnish and install complete ready for use, including all accessories required for operation.

B. Furnish: Purchase and deliver to the project site complete with every necessary appurtenance, support and accessories required for operation.

C. Install: 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.

1.4 DESCRIPTION OF SYSTEMS:

A. Furnish and install all materials for systems, resulting upon completion, in functioning systems in compliance with performance requirements specified. The omission of express reference to any parts necessary for or reasonably incidental to a complete installation shall not be construed as a release from furnishing such parts.

1.5 QUALITY ASSURANCE:

A. Equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service.

B. All equipment of one type (such as panelboards, breakers, etc.) shall be the products of one manufacturer.

1.6 REQUIREMENTS OF REGULATORY AGENCIES/CODE COMPLIANCE:

A. Contractors shall submit all items necessary to obtain all required permits to the appropriate Regulatory Agencies, obtain all required permits, and pay all required fees.

B. All work shall conform to the following Building Codes:
1. National Electrical Code (NEC-2017)
2. South Carolina Building Code (SCBC 2018)

C. All work shall conform to all federal, state and local ordinances.

D. References to the National Electrical Code and National Fire Protection Association (NFPA) are a minimum installation requirement standard. Design drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the NEC and NFPA.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS:

A. All products shall be new (except where noted) and unused and without blemish or defect.

PART 3 - EXECUTION

END OF SECTION 260500

SECTION 260501 - ELECTRICAL COORDINATION

PART 1 - GENERAL CONDITIONS

1.1 INTERPRETATION OF CONTRACT DOCUMENTS:

A. This section of the specifications and related drawings describe general provisions applicable to every section of Division 26.

B. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance with the intent diagrammatically expressed on the drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.

C. Certain details appear on the drawings which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not eliminate the requirement for field coordination for the indicated work.

D. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.

1.2 EXISTING CONDITIONS:

A. Bidders shall visit the premises and thoroughly familiarize themselves with details of the work, working conditions, verify dimensions in the field, advise the Architect/Engineer of any discrepancy, and submit shop drawings of any changes he proposes to make, in quadruplicate for approval, before starting the work. Contractor shall install equipment in a manner to avoid building interference.

1.3 SHOP DRAWINGS:

A. Do not purchase any materials or equipment prior to receipt of approved shop drawings.

B. Prior to assembling or installing the work, prepare and submit shop drawings for the following items electrical equipment as specified in subsequent sections.

C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Engineer to ascertain that the proposed equipment and materials comply with specification requirements.

D. Catalog cuts submitted for approval shall be legible and shall clearly identify equipment being submitted. Items that have been faxed or scanned are not acceptable.

E. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1.4 AS-BUILT DRAWINGS:

A. The installer shall keep a record set of drawings on the job and, as construction progresses, shall show the actual installed location of items, material, and equipment on these record set drawings.

1.5 OPERATING AND MAINTENANCE INSTRUCTIONS:

A. After final tests and adjustments instruct the Owner's Representative in the details of operation and maintenance for equipment installed.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION:

A. In addition to the requirements of the National Electrical Code, install an identification sign which will clearly indicate information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchgear and motor control assemblies, control devices and other significant equipment.

B. Nameplates shall be laminated black phenolic resin with a white core and engraved lettering, a minimum of 1/4-inch high. Nameplates that are furnished by manufacturer, as a standard catalog item, or where other methods of identification are herein specified, are exceptions.
1. Nameplates shall be attached with screws or rivets.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS:

A. Inspection:
1. Prior to any Work, the Contractor shall carefully inspect the installed Work of other Trades and verify that such Work is complete to the point where his installation may properly commence.
2. Verify that equipment may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Discrepancies:
1. In the event of discrepancy, immediately notify the Architect Engineer.
2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

C. Return to original (pre-construction) condition any paved areas, sidewalks, planting, etc., disturbed during electrical system installation.

3.2 INSTALLATION:

A. Install equipment in strict accordance with the manufacturer's recommendations and the shop drawings approved by the Engineer.

B. Secure equipment using fasteners suitable for the use, materials, and loads encountered. If requested, submit evidence proving suitability. Do not attach electrical materials to roof decking, removable or knockout panels, or temporary walls and partitions, unless indicated otherwise.

C. Equipment location: Shall be as close as practicable to locations shown on drawings.

D. Working spaces shall be not less than specified in the National Electrical Code for voltages specified.

E. Equipment and Materials:
1. New equipment and materials shall be installed unless otherwise specified.
2. Equipment and materials shall be designed to assure satisfactory operation and operating life for environmental conditions where being installed. NEC and other code requirements shall apply to the installation in areas requiring special protection such as explosion-proof, vapor-proof, watertight and weatherproof construction.

3.3 COORDINATION WITH OTHER TRADES:

A. Coordinate work of each section with work of other sections to avoid interference. Bidders are cautioned to check their equipment against space available as indicated on drawings and shall make sure that proposed equipment can be accommodated. If interferences occur, Contractor shall bring them to the attention of Architect/Engineer, in writing, prior to signing of contract; or, Contractor shall, at his own expense, provide proper materials, equipment, and labor to correct any damage due to defects in his work caused by such interferences.

3.4 WORK PERFORMANCE:

A. Arrange, phase and perform work to assure uninterrupted electrical service for other buildings. See General Methods of Procedure under Section GENERAL REQUIREMENTS.

B. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior condition.

C. Coordinate location of equipment and conduit with other trades to minimize interferences.

D. Cutting of Holes:
1. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills shall not be allowed.
2. Holes shall be located so as not to affect structural sections such as ribs or beams.
3. Holes shall be laid out in advance. The Architect shall be advised prior to drilling through structural sections, for determination of proper layout.

E. Where conduits, wireways, busduct, and other electrical raceways pass through fire partitions, fire walls or walls and floors, install a UL listed firestop assembly that matches the rating and is intended for the penetrated construction to provide an effective barrier

against the spread of fire, smoke and gases. Penetrations shall be made and the fire-stopping installed in accordance with manufacturers written instructions and UL details.

3.5 PROTECTION AND CLEANING OF SYSTEMS AND EQUIPMENT:

A. Protect materials and equipment from damage during storage at the Site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain.

B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering them with securely fastened protective rigid or flexible waterproof coverings.

C. Conduit shall be protected by storing it on elevated supports and capping the ends with suitable closure material to prevent dirt accumulation in the piping.

D. During construction cap the top of conduits and raceway installed vertically.

E. During installation, equipment, controls, controllers, circuit protective devices, etc., shall be protected against entry of foreign matter on the inside; and be vacuum cleaned both inside and outside before testing, operating and painting.

F. Damaged equipment shall be placed in first class operating condition or be returned to source of supply for repair or replacement.

G. Painted surfaces shall be protected with removable heavy kraft paper, sheet vinyl or equal, installed at the factory, and removed prior to final inspection.

H. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with same quality of paint and workmanship as used by manufacturer so repaired areas are not obvious.

3.6 DISPOSITION OF EXISTING MATERIAL AND EQUIPMENT:

A. Carefully remove and store on the site material and equipment noted or specified to be reused or relocated. Thoroughly clean this equipment prior to installation.

B. Remove other materials or debris resulting from demolition operations from the site.

3.7 IDENTIFICATION:

A. Upper case letters of uniform height; centered on device, coverplate, or enclosure; engraved letters filled with a contrasting color; and characters made clearly and distinctly.

B. Use abbreviations defined in the contract documents whenever possible. Use plan designations for labeling, unless indicated otherwise. Indicate loads served using designations from electrical schedules and designations from the trade furnishing the equipment served.

C. Label inside covers in exterior locations and outside covers in unfinished areas of the following with a permanent ink marking pen:
   1. Junction boxes or portions of junction boxes with 277 or 480 volt wiring;

2. Communications system pull and junction boxes
3. Pull, junction boxes, and raceway installed above ceilings and for future use.

D. Label feeder conductors and branch circuit conductors with self adhesive, numbered labeling tapes; Brady Co. or equal. Indicate feeder numbers on feeders and terminal numbers for control conductors. Label conductors at origin and destination points and at junction boxes where two or more feeder or control circuits are present.

3.8 ACCESS TO EQUIPMENT:

A. All equipment shall be installed in location and manner that will allow for convenient access for maintenance and inspection.

3.9 CONNECTION OF EQUIPMENT FURNISHED AND INSTALLED UNDER OTHER DIVISIONS OF THE WORK:

A. Rough-in and make final electrical connection to equipment requiring electrical connections with such equipment being furnished and installed under other Divisions of the Work.

B. Provide whatever incidental devices are necessary for final connection, such as, but not necessarily limited to outlet boxes, receptacles, connectors, clamps and switches.

3.10 GENERAL COMPLETION AND DEMONSTRATION:

A. Results expected:
1. Systems shall be complete and operational, and controls shall be set and calibrated.
2. Testing, start-up and cleaning work shall be complete.

3.11 CLEANING:

A. Periodically during construction and prior to Owner acceptance of the building, Contractor shall remove from the premises and dispose of packing material and debris.

B. Clear away debris and surplus material resulting from electrical work. Remove dust and debris from interiors and exteriors of electrical equipment. Clean accessible current carrying elements prior to being energized.

END OF SECTION 260501

SECTION 260503 - CUTTING, PATCHING AND REPAIR

PART 1 - GENERAL REQUIREMENTS

1.1 SCOPE OF WORK:

A. Cutting: Furnish all labor, materials, tools and equipment and perform all operations in connection with the cutting of new and existing building structure, finishes and building assemblies as specified hereinafter.

B. Patching: Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of watertight sealant as required to seal voids or gaps around Division 26000 equipment at penetrations through exterior floors, walls, and roof systems.

C. Repair: Furnish all labor, materials, tools and equipment required to repair all existing or new building components and finishes, outside components, landscaping, utilities, or other appurtenances that are damaged as a result of the performance of this contract.

D. All existing utilities, feeders, branch circuits, signal wiring, control wiring, etc. shall be reconnected to new or existing systems as required to maintain the same functions as existed prior to new work.

1.2 QUALITY ASSURANCE:

A. Sealants shall equal or exceed all requirements of ASTM E-814.

B. All applicable codes as stated elsewhere in these specifications for the type of work performed.

PART 2 - PRODUCTS

2.1 WATERPROOFING:

A. Exterior joint sealant shall be Polyurethane base, multi-component; self-leveling type for application in vertical joints; capable of withstanding movement of up to 50% of joint width and satisfactorily handled throughout temperature of 4 to 27 degrees C.; uniform, homogeneous, and free from lumps, skins and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining; non-bleeding; colors selected by Architect/Engineer.

B. The following waterproofing sealant manufacturers are acceptable:
1. TREMCO
2. Sonneborn - Contech
3. W. R. Meadows

PART 3 - EXECUTION

3.1 GENERAL:

A. Patch and repair all building finishes, structural components, or other appurtenances that are damaged as a result of the performance of this contract. Patch and repair work shall include finishes, components, substructure and materials required for the installation of such work in accordance with standard practices.

B. Replace all building components, outside components, shrubbery, or other appurtenances which are damaged beyond repair. Replacement item(s) shall be of equal or higher quality than the original item(s).

C. All penetrations thru exterior floors, walls, and roof systems shall be sealed watertight.

D. All roof penetrations shall be patched in accordance with roofing manufacturers' recommendations.

E. Patched and repaired work shall be finished to match existing or adjacent construction and conditions.

3.2 INSTALLATION OF SEALANT MATERIALS:

A. Install materials in accordance with manufacturer's recommendations for installation of these materials.

B. Clean and prepare joints for sealant application in accordance with manufacturer's recommendations. Ensure that joint forming materials are compatible with sealant. Use joint filler to achieve required joint depths. Apply primers as recommended by sealant manufacturer.

C. Openings larger than required for proper installation of electrical raceways or conduits shall be patched or repaired.

END OF SECTION 260503

SECTION 260519 - WIRE AND CABLE - BUILDING WIRE (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 SCOPE:

A. This section includes the furnishing, installation, and connection of the building wire for power and lighting circuits.

B. Unless otherwise specified in other sections of these specifications, control wiring shall be provided, installed, and connected to perform the functions specified in other sections of these specifications.

C. Unless otherwise specified in other sections of these specifications, communication and signal wiring shall be provided, installed, and connected to perform the function specified in other sections of these specifications.

1.2 APPLICABLE PUBLICATIONS:

A. The following specifications and standards, except as hereinafter modified, are incorporated herein by reference and form a part of this specification to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of Invitation for Bids shall be applicable. In text such specifications and standards are referred to by basic designation only.

1. National Fire Protection Association (NFPA) Publications
   No. 70 . . . . . .National Electrical Code (NEC)
2. Underwriters' Laboratories, Inc. (UL) Publications:
   No. 44 . . . . . .Rubber-Insulated Wire and Cables
   No. 83 . . . . . .Thermoplastic-Insulated Wires
   No 493 . . . . . .Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables
   No. 486. . . . . .Wire Connectors and Soldering Lugs

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Building Wire (Power and Lighting):

1. Cable and wire shall be in accordance with UL, NEC, as shown on the drawings, and as hereinafter specified.
2. Conductors:
   a. Shall be annealed copper.
   b. Shall be stranded for sizes No. 8 and larger. Sizes No. 10, and smaller shall be solid.
   c. Size shall be not less than shown on the drawings. Minimum size shall be No. 12 AWG.
3. Insulation: Unless otherwise shown on the drawings, insulation shall be as follows:
   a. THHN - THWN – Dry, Damp, Wet Locations
   b. XHHW – Dry, Damp, Wet Locations.

4. Color Code:
   a. All secondary service, feeder, and branch circuit conductors shall be color coded as follows:

208/120 Volt	Phase	480/277 Volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray

   b. All No. 12 and No. 10 branch circuit conductors shall have solid color compound or solid color coating.
   c. No. 8 AWG and larger phase conductors shall have either:
      1) Solid color compound or solid color coating.
      2) Stripes, bands, or hash marks of colors specified above.
      3) Colored pressure-sensitive plastic tape. Tape shall be applied in half overlapping turns for a minimum of three inches for all terminal points, and in all junction boxes, pull boxes, troughs, manholes, and handholes. Tape shall be 3/4-inch wide with colors as specified above. The last two laps of tape shall be applied with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
   d. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.

B. Splices and Joints:
   1. Shall be in accordance with UL and NEC.
   2. Branch circuits (No. 10 AWG and smaller):
      a. Connectors shall be solderless, screw-on, pressure cable type, 600 volt, 105 degree C, with integral insulation. They shall be approved for copper conductors, and shall be reusable.
      b. The integral insulator shall have a skirt to completely cover the stripped wires.
      c. The number, size, and combination of conductors as listed on the manufacturers packaging shall be strictly complied with.
   3. Feeder Circuits:
      a. Connectors shall be indent, hex screw, or bolt clamp-type. Material shall be high conductivity and corrosion-resistant.
      b. Connectors for cable sizes 250 MCM and larger shall have not less than two compression indents.
      c. Splices and joints shall be insulated with materials approved for the particular use, location, voltage, and temperature. Insulation shall be not less than that of the conductors being joined.
      d. Plastic electrical insulating tape:
         1) Tape shall be flame retardant, cold and weather resistant.

C. Control Wiring:
   1. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring.

2. Wire size shall be large enough so that the voltage drop under inrush conditions will not adversely affect operation of the controls.

D. Wire Lubricating Compound shall be suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. All wiring shall be installed in raceway systems. Installation shall be in accordance with the NEC, as shown on the drawings, and as hereinafter specified.

B. Cables and wires shall be spliced only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.

C. Wire Pulling:
1. Suitable installation equipment shall be provided to prevent cutting or abrasion of conduits during pulling of feeders.
2. Ropes used for pulling feeders shall be made of suitable nonmetallic material.
3. Pulling lines for feeders shall be attached by means of either woven basket grips or pulling eyes attached directly to the conductors.
4. All cables to be pulled in a single conduit shall be pulled in together.

3.2 FIELD TESTING:

A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.

B. Test shall be performed by megger and conductors shall test free from short-circuits, grounds, and opens.

C. Conductors shall be tested phase-to-phase and phase-to-ground.

END OF SECTION 260519

SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. This section includes the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounding systems.

B. The term ground, as used in this specification, shall mean any or all of the grounding types specified.

1.2 QUALITY ASSURANCE:

A. NEC Compliance: Comply with NEC requirements as applicable to materials and installation of electrical grounding systems, associated equipment and wiring. Provide grounding products which are UL listed and labeled.

B. UL Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to electrical grounding and bonding.

C. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical grounding.

PART 2 - PRODUCTION

2.1 GENERAL:

A. Provide electrical grounding systems with assembly of materials, including cables/wires, connectors, terminals, solderless lugs, grounding rod/electrodes, bonding jumper braid and additional accessories needed for complete installation. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE and established industry standards.

2.2 GROUNDING CONDUCTORS:

A. Shall be UL and NEC approved types, copper, with insulation color identified green, except where otherwise shown on the drawings, or specified.

B. Wire size shall not be less than #12 AWG and not less than required by the NEC.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL GROUNDING:

A. General: Install electrical grounding systems in accordance with applicable portions of NEC, with NECA's "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.

3.2 FEEDERS AND BRANCH CIRCUITS:

A. Install green insulated equipment grounding conductors with all feeders and branch circuits. Conductors shall be sized in accordance with NEC Article 250.

3.3 EQUIPMENT GROUNDS:

A. All equipment that has electrical connections (lights, receptacles, panels, and utilization equipment) shall have a ground wire connected that is directly tied to the ground bus of the panel which serves it.

B. Fixed electrical appliances and equipment shall have a ground lug installed and provided by this contractor for termination of the green ground conductor.

END OF SECTION 260526

SECTION 260533 - CONDUITS/RACEWAYS AND FITTINGS

PART 1 - GENERAL

1.1 SCOPE:

A. This section includes the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems.

B. Types of raceways in this section include the following:
1. Rigid metal conduit (RMC or GRC)
2. Intermediate metal conduit (IMC)
3. Electrical metallic tubing (EMT)
4. Flexible metal conduit (FMT)
5. Liquidtight flexible metal conduit (LFMC)
6. Rigid PVC conduit (PVC)

C. The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 QUALITY ASSURANCE:

A. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.

B. UL Compliance and Labeling: Comply with provisions of UL safety standards pertaining to raceways systems; and, provide products and components which have been UL listed and labeled.

C. NEC Compliance: Comply with requirements as applicable to construction and installation of raceway systems.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC OR GRC):

A. Rigid metal steel conduit shall conform to ANSI C80.1 and Underwriter's Laboratories UL-6 specification, ANSI C80.1.

B. Conduit shall be hot-dipped galvanized to provide a corrosion resistant coating.

C. Fittings: Fittings shall be ANSI/NEMA FB 1 threaded type, hot dipped or electronic plated. Threaded conduit to be secured to boxes, cabinets, etc., by means of galvanized threaded bushings on the inside and bond-type locknuts on the inside and outside of such boxes and cabinets. Fittings shall be watertight and the same material as conduit installed with factory manufactured elbows.

2.2 RIGID INTERMEDIATE STEEL CONDUIT (IMC):

A. Intermediate Metallic Conduit shall conform to ANSI C80.1 and proposed Underwriter's Laboratories UL 1242 specification.

B. Conduit shall be hot-dipped galvanized to provide a corrosion resistant coating. Intermediate Metallic Conduit (IMC) shall have galvanized/metallized thread protection, and pipe interior shall be protected by corrosion inhibiting coating.

C. Fittings: Shall be similar to GRC.

D. Maximum allowable size shall be (4) inches.

2.3 ELECTRICAL METALLIC TUBING (EMT):

A. Electrical metallic tubing shall conform to ANSI C80.3 and Underwriter's Laboratories UL 797.

B. EMT shall be hot-dipped galvanized steel with internal coating of silicone epoxy lubricant to assist in wire pulling.

C. Fittings: Shall be compression type, steel or malleable iron. Set screw or indentation type of fittings are not acceptable.

2.4 FLEXIBLE METAL CONDUIT (FMC):

A. Flexible metal conduit shall conform to UL 1.

B. Flexible conduit to be of hot-dipped galvanized interlocked spirally wound steel strip.

C. Fittings shall be multiple point type, threading into the internal wall of the conduit convolutions, and shall have insulated throat. Connectors to be galvanized and be suitable for connection to associated boxes and conduits.

2.5 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC):

A. Liquid-tight flexible metal conduit shall conform to UL 360.

B. Liquid-tight flexible metal conduit shall consist of flexible galvanized steel tubing over which is extruded a liquid-tight jacket of polyvinyl chloride (PVC). Conduit shall be provided with a continuous copper bonding conductor wound spirally between the convolutions.

C. Fittings used shall be reusable type of malleable iron/steel construction, electro zinc plated inside and outside, furnished with nylon insulated throat and taper threaded hub. Connectors to be galvanized and be suitable for connection to associated boxes and conduits.

2.6 RIGID PVC (PVC):

A. Conduit shall be UL rated 90°C and to UL-651. Fittings shall conform to UL-514.

B. Conduit shall be S40 wall thickness made from polyvinyl chloride (recognized by UL) compound which includes inert modifier to improve weatherability and heat distortion. Conduit and couplings shall be homogenous plastic material free from visible cracks, holes, or foreign inclusions. Conduit bore shall be smooth and free from blisters, nicks, or other imperfections which could mar conductors or cables.

C. Bends: 90° bends shall be made with galvanized rigid steel elbows. Bends other than 90° shall be made from S80 PVC conduit.

2.7 CONDUIT SUPPORTS:

A. Parts and hardware shall be zinc-coated or have equivalent corrosion protection.

B. Pipe straps: Fed. Spec. FF-S-760, type 1, style A or B.

C. Individual conduit hangers: Shall be designed for the purpose, and have pre-assembled closure bolt and nut, and provisions for receiving hanger rod.

D. Multiple conduit (trapeze) hangers shall be not less than 1-1/2 x 1-1/2 inch, 12 gage steel, cold formed, lipped channels. Hanger rods shall be not less than 3/8 inch diameter steel.

E. Solid masonry and concrete anchors: Fed. Spec. FF-S-325 shall apply. Anchors shall be GROUP III self-drilling expansion shields, or machine bolt expansion anchors GROUP II type 2 or 4, or GROUP VII.

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION SCHEDULE:

A. Conduits utilized shall be metallic conduit types listed in this specification. Metallic conduit types shall be applied for specific system types as follows:
   1. Power distribution feeders such as feeders for switchboards, panelboard, transformers, etc.:
      a. Exposed or concealed - RMC or IMC
      b. Below slabs on grade or underground outside of building - PVC
   2. Feeders to motors: Same requirements as power distribution feeders.
   3. Branch circuits from panelboards (not described above):
      a. Wet or damp locations exposed or concealed - RMC or IMC
      b. Dry locations exposed or concealed - EMT.
      c. Below slabs on grade or underground outside of building - PVC
   4. Low voltage systems such as building automation and control systems, information technology systems: Same requirements as branch circuits.

3.2 CONDUIT INSTALLATION:

A. Installation shall be in accordance with UL, NEC, as shown on the drawings, and as hereinafter specified.

B. Contractor shall lay out and install conduit runs to avoid proximity to hot pipes. In no case will a conduit be run within three inches of such pipes, except where crossings are unavoidable and then conduit shall be kept at least one inch from the covering on pipe crossed.

C. Conduits shall be supported as required to comply with applicable paragraphs of the NEC.

D. Conduit installation shall be as follows:
   1. Installed as complete runs before pulling in cables or wires.
   2. Installed so they will not obstruct head room, walkways, doorways or work by other trades.
   3. Cut square with a hacksaw, reamed, burrs removed, and drawn up tight.
   4. Mechanically continuous.
      a. Metallic raceway shall also be electrically continuous.
   5. Supported within one foot of changes of direction, and within one foot of each enclosure to which connected.
   6. Ends of empty conduit to be closed with plugs or caps at rough-in stage to prevent entry of debris until wires are pulled in.
   7. Conduits shall be secured to cabinets, junction boxes, pull boxes, and outlet boxes by bonding type locknuts.
   8. See architectural detail for conduit penetrations of roof membrane.

E. Conduit Bends:
   1. Shall be made with standard conduit bending machines.
   2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
   3. Conduits shall not be bent with a pipe tee or vice.

F. Conduit shall be securely fastened in place at intervals as specified by the code using suitable straps, hangers and other supporting assemblies. Strap hangers and supporting assemblies:
   1. Shall be of rugged construction capable of supporting weight with a reasonable factor of safety.
   2. Spacers and supporting straps shall be of rugged malleable iron or steel construction hot dipped galvanized.
   3. Shall be adequately protected against corrosion.

G. In wet locations or in locations where corrosive conditions are present, vertical and horizontal runs of conduit shall be firmly supported so that there is at least 1/4" air space between the conduit and the wall or supporting surface. Spacers and supporting straps shall be of malleable iron construction, hot dipped galvanized.

H. Flexible conduit when installed shall have sufficient slack to avoid sharp flexing and straining due to vibration and thermal expansion/construction. Conduit shall be installed in such a manner that liquids will tend to run off the surface instead of draining towards the fittings.

I. Concealed work installation:
   1. In cast-in-place:
      a. Conduits may be installed in concrete that is at least than 3 times conduit trade size in thickness but in no case less than 3” thick.
      b. Conduit shall be run in direct lines.
      c. Conduit may be installed through concrete beams where shown on the structural drawings or as approved by the Engineer prior to installation.
         1) Submit drawings showing locations size, and position of each proposed penetration for review prior to installation.
      d. Spacing between conduits in slab shall be approximately six conduit diameters apart except one conduit diameter at conduit crossings.
      e. Conduits shall be installed approximately at the center of the slab.

f. Couplings and connections shall be concrete tight. Thread compounds shall be UL approved conductive type to ensure low resistance ground continuity through the conduits.

2. In CMU (Concrete Masonry Unit) Walls:
   a. Conduits shall run vertically within CMU walls except where noted on the drawings or as approved by the Engineer prior to construction.
3. Conduit shall be run parallel or perpendicular to the building lines.
4. Branch circuit conduits, and conduits feeding ceiling lighting shall be supported independently from suspended ceiling, lighting fixtures, or air conditioning ducts.
5. Recessed lighting fixtures shall be connected to conduit with not over six feet of flexible metal conduit.

J. Exposed work installation:
1. Conduit shall be run parallel or perpendicular to the building lines.
2. Horizontal runs shall be installed close to the ceiling or beams and secured with approved conduit straps.
3. Horizontal or vertical runs shall be supported at not over eight foot intervals.

K. Installation underground or below slabs on grade:
1. Tops of conduits shall be:
   a. Not less than 24 inches and not less than shown on the drawings below finished grade.
   b. Not less than 30 inches and not less than shown on the drawings below road and other paved surfaces.
2. Conduits shall be installed below power company direct burial primary feeders where encountered. Coordinate spacing below primary feeder with utility company.
3. Underground conduits shall be encased in not less than 3" of red cast-in-place concrete (all around) where run outside of buildings or equipment pads.

L. Transition from PVC to metallic conduit:
1. Where PVC conduit exits permitted locations, coated rigid galvanized or IMC conduits shall be utilized for the transition. Acceptable coatings are factory applied PVC or field applied spray bituminous or tape coatings intended for the application.
   a. Where conduits transition under pad-mounted equipment enclosures such as switchboards, generators or pad-mounted transformers, it shall be acceptable to utilize PVC for the transition.
2. Transition to metallic conduits shall occur minimum 12 times conduit trade diameter prior to exit from permitted locations. Distance shall be measured from point of exit for horizontal transitions and from center of conduit at point of exit for horizontal to vertical transitions.

M. Surface metal raceways:
1. Surface metal raceways shall be used only where shown on the drawings.

3.3 MOTORS AND VIBRATING EQUIPMENT:

A. Flexible metal conduit shall be used for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission. Flexible metal conduit shall be liquid-tight when installed in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray

wash-down operations, and locations subject to seepage or dripping of oil, grease or water. Flexible metal conduit shall be installed with green ground wire.

3.4 CONDUIT SUPPORTS, INSTALLATION:

A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.

B. Pipe straps or individual conduit hangers shall be used for supporting individual conduits.

C. Multiple conduit runs shall be supported by trapeze hangers. Trapeze hangers shall be designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 200 pounds. Each conduit shall be attached by U-bolt or other approved fastener.

D. Conduit shall be supported independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, etc.

E. Solid Masonry and Concrete: Fasteners shall be as follows:
1. New construction: Generally, steel or malleable iron concrete inserts in concrete prior to pouring.
2. Existing construction:
a. Steel expansion anchors not less than 1/4-inch bolt size and not less than
1-1/8 inch embedment.
b. Power set fasteners shall be approved, and not less than 1/4-inch diameter with depth of penetration not less than three inches.
c. Anchors or fasteners attached to concrete ceilings shall be vibration and shock resistant.

F. Hollow masonry. Toggle bolts are permitted. Bolts supported only by plaster are not acceptable.

G. Metal structures. Fasteners shall be machine screw or devices specifically designed and approved for the application.

3.5 LOW VOLTAGE SYSTEM CONDUIT:

A. Minimum size conduit shall be 3/4", but not less than shown on the drawings.

B. Conduit bends and elbows shall be long radius.

3.6 PULL WIRES:

A. Install a # 14 gauge fish wire in empty conduits, except telephone and communications. Install a nylon pull string in telephone and communication conduits.

END OF SECTION 260533

SECTION 260535 - ELECTRICAL BOXES

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. This section includes the furnishing, installation and connection of all outlet boxes, junction boxes, and floor boxes as shown on the drawings or as required to house the intended wiring, devices or equipment.

B. Types of electrical boxes and fittings specified in this section include the following:
1. Outlet boxes
2. Junction boxes
3. Pull boxes
4. Bushings
5. Locknuts
6. Knockout closures

1.2 QUALITY ASSURANCE:

A. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.

B. UL Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL listed and labeled.

C. NEMA Compliance: Comply with applicable requirements of NEMA Stds./Pub No.'s OS1, OS2, and Pub 250 pertaining to outlet and device boxes, covers, and box supports.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS:

A. Outlet and Device Boxes (dry interior locations): Provide galvanized coated sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as required by particular application, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with conduit size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.

B. Outlet and Device Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations.
1. Plaster rings and device mounting rings shall be of proper depth such that the device mounting surface is flush with the finished wall/ceiling surface.

C. Outlet and Device Boxes (damp and wet locations): Provide corrosion resistant cast metal raintight outlet and wiring device boxes of types, shapes and sizes required for each application, including depth of boxes, with threaded conduit holes for fastening electrical conduit, and cast metal face plates. Where weatherproof devices are indicted, provide spring hinged watertight caps suitable configured for each application, including face plate gaskets and corrosion resistant plugs and fasteners.

D. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suite each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

E. Bushings, Knockout Closures, and Locknuts: Provide corrosion resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:

A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

C. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.

D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

3.2 GROUNDING:

A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

END OF SECTION 260535

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. This section includes the furnishing and installation, at locations shown on the drawings, of approved panelboards of a type indicated and specified herein.

1.2 RELATED WORK/SECTIONS:

A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
   1. Division 1
   2. All other Division 26000 sections

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in the NEC, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NEC.

F. Panelboards shall comply with UL 67.

G. Cabinet and boxes shall comply with UL 50.

1.4 SUBMITTALS:

A. Submit catalog cuts and descriptive literature for approval in accordance with Section 260500, ELECTRICAL GENERAL REQUIREMENTS.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB1.

C. Environmental Limitations:
   1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete,

and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Service Conditions: NEMA PB1.

1.6 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate circuit breakers and fused switch sizes for branch circuit and feeders serving equipment furnished by other trades of work prior to submitting panelboard shop drawings. Note overcurrent protection size adjustments in panelboard submittals.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 LABELING:

A. All panels shall be UL labeled.

B. All panels used as a service entrance, shall be labeled as such.

C. A nameplate shall be provided listing panel type and ratings.

2.2 GENERAL PANELBOARD CONSTRUCTION:

A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL, and established industry standards for those applications indicated.

B. Distribution, Lighting, and Appliance Panelboards: Provide dead-front safety constructed factory assembled circuit breaker type panelboards in sizes and ratings as indicated. Construct with rectangular shaped copper or tin-plated aluminum bus bars which are securely mounted and braced, and with lugs bolted to main bus bars.

C. Provide anti-turn solderless pressure type lug connectors approved for copper conductors, and construct unit for connecting feeders at top of panel.

D. Equip with full-sized neutral bus bar with suitable lugs for circuits requiring neutral connection. Provide suitable lugs on neutral bus for each outgoing feeder required.

E. Provide main and branch circuit breakers. Breakers shall be molded case bolt-in type, heavy-duty, quick-make, quick-break, with toggle handles that indicate when tripped. Where multipole breakers are indicated, provide with common trip so that overload on one pole will trip all poles simultaneously.
1. Circuit breakers for branch circuit panelboards and circuit breakers 125A and smaller for distribution panelboards shall be thermal-magnetic type.
2. Circuit breakers 150A through 800A for distribution panelboards shall be solid state trip LSI type, 80% rated.
3. Circuit breakers 1000A and larger for distribution panelboards shall be solid state trip LSIG type, 100% rated.

F. Provide bare uninsulated grounding bars suitable for bolting to enclosures.

G. Load center type panelboards are not acceptable, unless specifically called for in drawings.

H. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness, with baked gray enamel finish over a rust inhibitor coating. Construct with multiple knockouts and wiring gutters. All panelboard locks shall be keyed alike. Door hinges shall be piano hinges. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate properly with panelboards to be enclosed. Equip with interior circuit-directory frame, and card with clear plastic covering.
1. Surface mounted panelboard fronts shall be door-in-door type, with locks and keys for both inner and outer doors.
2. Flush mounted panelboard fronts shall be hinged front type, with lock for inner door and screw fasteners for outer door.

I. Panelboard Accessories: Provide panelboard accessories and devices including, but not limited to circuit breakers as recommended by panelboard manufacturer for ratings and applications indicated.

J. Panelboards shall be shown in the following schedule, or approved equal, and shall be completely factory assembled. Do not purchase panelboards or cabinets until shop drawings have been approved.
1. Branch Circuit Panelboards (120/208 or 120/240 V Operation). Minimum cabinet width shall be 20":
   Square D NQ
2. Distribution Panelboards:
   Square D I-Line

K. Where a specific interrupting rating is shown on the drawings, panelboards and associated circuit breakers shall be fully rated for that value as a minimum. Series rating of equipment is not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION OF PANELBOARDS:

A. General: Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.

C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A.

D. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.

E. Provide properly wired electrical connections within enclosures.

F. Fill out panelboard's circuit directory card upon completion of installation work. Type text, handwriting is not acceptable. Directory shall reflect actual installation configuration and shall incorporate final room numbers. Room numbers shown on architectural plans shall not be used for the directory.

G. Installation shall comply with the NEC.

H. Anchor to walls per manufacturer's recommendation.

I. Lace all feeder cables with tie wraps in panel housing. All wiring shall be run square inside housing.

J. Vacuum panel housing to remove all dust and dirt from housing prior to final inspection.

K. Cover panel housing prior to room painting. Clean all paint from panel.

L. Provide engraved plastic identification label black face with white lettering, indicating panelboard name, voltage system, and upstream distribution including room name and number. Attach identification labels to panel with rivets or sheet metal screws.
   1. Labels for panels fed from the emergency power system shall have red faces with white lettering.

3.2 GROUNDING:

A. Provide equipment grounding connections for panelboards as indicated. Tighten connections to comply with tightening torques specified in UL Stds. 486A to assure permanent and effective grounds.

3.3 FIELD QUALITY CONTROL:

A. Prior to energization of circuitry, check all accessible connections to manufacturer's tightening torque specifications.

B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

C. Prior to energization, check panelboards for electrical continuity of circuits, and for short circuits.

D. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units and then retest to demonstrate compliance.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SCOPE:

A. This section includes the furnishing, installation, and connection of wiring devices as shown on the plans.

B. Types of electrical wiring devices in this section include the following:
1. Receptacles
2. Switches
3. Faceplates
4. Motor rated toggle switches

1.2 QUALITY ASSURANCE:

A. NEC Compliance: Comply with NEC as applicable to installation and wiring of electrical wiring devices.

1.3 SUBMITTALS:

A. Submit catalog cuts and descriptive literature for approval in accordance with Section 26 0500, ELECTRICAL GENERAL REQUIREMENTS.

B. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

C. The specific item proposed and its area of application shall be marked on the catalog cuts.

PART 2 - PRODUCTS

2.1 FABRICATED WIRING DEVICES:

A. General: Provide factory-fabricated wiring devices, in types, colors, and electrical ratings for applications indicated. Unless noted otherwise device color shall be ivory. Wiring devices shall comply with NEMA publications WD1 and WD6.

B. Receptacles shall comply with Federal Spec WC-596.

C. Toggle switches shall comply with Federal Spec WS-896.

D. Wiring Devices: 15 and 20A, 120 V devices shall employ modular connections without exposed wiring terminals. Acceptable products are as follows.

1.	Legrand/P&S	Plugtail
2.	Hubbell	SnapConnect
3.	Leviton	Lev-Lok

E. Wiring devices shall be as listed in the following table, or approved equal:

Description	Legrand	Hubbell	Leviton
20A 125V 2P 3W Grounded Duplex Tamper Resistant Receptacle (NEMA 5-20R)	PTTR5362I	SNAP5362ITR	M5362-I
20A 125V 2P 3W Grounded Duplex Tamper Resistant Ground Fault Interrupter (NEMA 5-20R)	PT2097TRI	GFTWRST20SNAPI	MGFT2-I
20A 125V 2P 3W Grounded Duplex Ground Fault Interrupter weather resistant (NEMA 5-20R)	2097TRWR	GFWRST20	G5362-WTT
30A, 600V 2P Motor Rated Toggle Switch	7802MD	HBL7832D	MS302-DS

2.2 WET AND DAMP LOCATION RECEPTACLES:

A. Type “WP” - Wet Locations: Weatherproof receptacles shall be a weather resistant duplex GFCI receptacles as specified under 262726 WIRING DEVICES, Part 2.1.C, mounted in cast metal outlet box fitted with a gasketed "while-in-use" metal cover, Hubbell WP26E or Pass & Seymour WIUC10-CAGV or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES:

A. Install wiring devices as indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

3.2 GROUNDING:

A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

3.3 TESTING:

A. Prior to energizing circuitry, test wiring for electrical continuity, and for short circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 262726

SECTION 262816 - SAFETY/DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. This section includes the furnishing, installation, connection, and wiring of safety switches.

1.2 QUALITY ASSURANCE:

A. Safety/Disconnect switches shall conform to Underwriter's Laboratories UL 98, "Enclosed and Dead-Front Switches."

1.3 SUBMITTALS:

A. Submit catalog cuts and descriptive literature for approval in accordance with Section 260500, ELECTRICAL GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

2.1 GENERAL SAFETY/DISCONNECT SWITCH FEATURES:

A. Switches shall be NEMA type HD (Heavy Duty) and UL listed.

B. All switches shall have switch blades which are fully visible in the "OFF" position when the switch door is open. All current carrying parts shall be plated to resist corrosion and promote cool operation. Switches shall have removable arc suppressors where necessary to permit easy access to line side lugs. Lugs shall be front removable and UL listed for 60 degrees C and 75 degrees C, aluminum or copper wires.

C. Switches shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started. The operating handle shall be an integral part of the box, not the cover. Provisions for padlocking the switch in the "OFF" position with at least three locks shall be provided. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door when the handle is in the "ON" position, and to prevent closing of the switch mechanism with the door open. The handle position shall indicate whether the switch is "ON" or "OFF".

D. Switches shall be horsepower rated for AC and/or DC as indicated by the plans. All fusible switches rated 100 thru 600 amperes at 240 volts and 30 thru 600 amperes at 600 volts shall have a UL approved method of field conversion from standard Class H fuse spacing to Class J fuse spacing. The switch also must accept Class R fuses and have provisions for field installation of a UL listed rejection feature to reject all fuses except Class R. The UL listed short circuit rating of the switches shall be 200,000 rms symmetrical amperes when Class R or Class J fuses are used with the appropriate rejection scheme. The UL listed short circuit rating of the switch, when equipped with Class H fuses, shall be 10,000 rms symmetrical amperes. 800 and 1200 ampere

switches shall have provisions for Class L fuses and shall have a UL listed short circuit rating of 200,000 rms symmetrical amperes.

E. Disconnect switches shall be equipped with ground lug.

2.2 NEMA 1 AND 3R HEAVY DUTY SAFETY/DISCONNECT SWITCHES:

A. Switches shall be furnished in NEMA 1 general purpose enclosures unless exposed to weather which shall be NEMA 3R. Covers on NEMA 1 enclosures shall be attached with pin type hinges. NEMA 3R covers shall be securable in the open position. NEMA 3R enclosures for switches thru 200 amperes shall have provisions for interchangeable bolt-on hubs. Hubs shall be as indicated on the plans. NEMA 3R enclosures shall be manufactured from galvanized steel. Enclosures shall have a gray baked enamel finish, electrodeposited on cleaned, phosphatized steel.

2.3 SPECIFIED MANUFACTURERS:

A. Specified manufacturers shall be as follows, or approved equal:
1. General Electric
2. Square D
3. Eaton
4. Siemens

PART 3 - EXECUTION

3.1 INSTALLATION LOCATION:

A. As a general rule, install switches on the equipment it serves, if shown that way on the drawings.

B. Do not install switch on equipment removable panel.

C. All switches shall be accessible.

3.2 GROUNDING:

A. Connect ground wires to ground lug.

B. See section - GROUNDING.

3.3 CONDUIT BUSHINGS:

A. Use plastic bushings where conduit enters switch.

END OF SECTION 262816

SECTION 230993.6 - SEQUENCE OF OPERATION (SINGLE ZONE PACKAGED EQUIPMENT)

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of controls system shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
1. Section 230993 - Sequence of Operations for HVAC Controls and Points List

PART 2 - SEQUENCE OF OPERATION

2.1 GENERAL:

A. Unit Operation:
1. The indoor fan, exhaust fan, compressors, heating coil, reheat coil, and outside air damper shall be controlled independently of each other by the direct digital controller.
2. Cooling and heating shall not operate simultaneously except where specifically specified otherwise.
3. Electric heat shall be disabled until air flow switch proves proper air flow.
4. When system is in occupied or override modes, the system shall operate in occupied mode.

B. Heating Control (Heat Pump):
1. Upon a demand for heating, the reverse cycle unit shall load compressor.
2. If additional heat is required or the compressor fails to energize, the auxiliary heat shall be energized.
3. Electric heat shall be energized during the defrost cycle.
4. Electric heat shall stage (single or multiple) or proportionally energize as indicated on equipment schedule or specifications to maintain sensor setpoint.

C. Cooling Control:
1. Upon a demand for cooling, the unit cooling sequence shall energize.
2. The compressors shall load to maintain sensor setpoint.

D. Indoor Fan Operation:
1. The fan shall run continuously when the unit is energized except where noted otherwise.

E. Morning Warm-Up:
1. Unit shall operate in heating to bring space to design temperature.

F. Outside Air Damper:
1. The outside air damper shall be closed during unoccupied mode.
2. The outside air damper shall be closed during morning warm-up mode.
3. The outside air damper shall be open during occupied mode.

G. Unoccupied Mode:
1. When space temperatures drop below the night low limit setpoint, the unit shall energize in heating.
2. When space temperatures rise above the night high limit setpoint, the unit shall energize in heating.
3. When the space humidity rises above setpoint, the system shall operate in dehumidification mode.

H. Failure Mode:
1. High condensate level
2. Smoke detection
3. Freezestat
4. Others indicated with equipment or required by manufacturer.

2.2 WALL MOUNTED HEAT PUMPS:

A. Dehumidification Mode:
1. The unit shall operate in full cooling mode when humidity level exceeds setpoint.
2. The reheat coil shall energize and maintain the space temperature setpoint.

END OF SECTION 230993.6

SECTION 233112 - MECHANICAL DUCT

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the installation of mechanical duct, accessories, and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

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

B. All sections of Division 23 Specifications apply to this section. In addition, refer to these specification sections:
1. Section 233113.01 - Metal Duct
2. Section 233300 - Duct Accessories
3. Section 233313 - Dampers
4. Section 233346 - Flexible Duct

1.3 QUALITY ASSURANCE:

A. Codes and Standards:
1. Mechanical duct systems shall be fabricated and installed in accordance with the manufacturer's recommendations and meet or exceed the standards and procedures (latest editions) of the following:
a. SMACNA, Balancing and Adjustment of Air Distribution
b. SMACNA, Low Pressure Duct Construction Standards
c. SMACNA, Duct Cleanliness for New Construction Guidelines
d. SMACNA, HVAC Duct Construction Standards
e. NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems
f. ASHRAE Handbook of Fundamentals and ASHRAE Systems and Equipment Handbook
g. International Building Codes
2. Duct shall be Class 0 in accordance with UL Standard 181. Where permitted by Code, Class 1 duct shall be allowed.
3. All duct system components including insulations, adhesives, mastics, cements, tapes, coverings, connectors and appurtenances shall have a maximum UL flame spread of 25 and a smoke development rating of 50 as tested by ASTM E-84.
4. Duct sealants shall meet UL 181A and UL 181B.

B. Manufacturers:
1. The following duct sealant manufacturers are acceptable:

a. AirSeal McGill
b. Ductmate
c. Hardcast

PART 2 - PRODUCTS

2.1 GENERAL:

A. Dimensions shown on the plan are finished inside dimensions. The sizes of internally lined ducts shall be increased accordingly. The size of dampers, security bars and accessories shall also be increased in size.

B. Ducts shall be smooth on inside.

C. The general location of ducts shall be as shown on the contract drawings. Exact location of ductwork shall be determined by the Contractor.

2.2 SEALING DUCTS:

A. General:
1. Sealants shall be water based. Solvent based sealants are not acceptable.
2. Sealants shall be UV, water and mildew resistant.
3. Sealants shall be suitable for low, medium and high pressure applications up to 15" WG.
4. Sealants shall have a mild odor, no flashpoint, and not require a respirator for application.

B. All ducts shall be sealed in accordance with Seal Class A. Seal all joints (longitudinal and traverse) and all penetrations. The following shall not require sealant:
1. Spiral lockseams
2. Gasketed connections

C. Basis of design sealant (not exposed to weather) shall be:
1. McGill AirSeal United Duct Sealer (Water Based).

D. Basis of design sealant (exposed to weather) shall be:
1. McGill AirSeal Uni-Weather.

2.3 DUCT SHIPMENT:

A. Intermediate Level (SMACNA):
1. Ducts leaving the place of fabrication shall be kept clean and dry.

PART 3 - EXECUTION

3.1 GENERAL:

A. Contractor shall provide additional bends and offsets as may be required to bring ductwork into proper relation with other equipment and features of the building.

B. Where changes are made in shape of ducts, full area shall be maintained and changes shall be gradual to minimize pressure drop.

C. Ducts terminating at grilles and registers shall be provided with suitable means of attachment.

D. All ductwork shall operate without chatter and vibration, and shall be free from pulsation.

E. The following work shall be performed under direction of the System Test and Balance Contractor.
   1. Install all automatic dampers.
   2. Provide necessary blank-off plates (safing) required to install dampers that are smaller than duct size.
   3. Assemble multiple section dampers with required number of shafts through duct for external mounting of damper motors.
   4. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and affix and seal permanently in place after stratification problem has been eliminated.
   5. Provide access doors to adjust, maintain, or service equipment sensors, controllers and all other devices.

3.2 DUCT STORAGE:

A. Duct shall be protected by storing on elevated supports.

B. All ducts shall have ends capped during storage.

C. The area used for storage shall be kept dry and clean.

3.3 PROTECTION AND CLEANING DURING INSTALLATION:

A. During construction, all open ends of duct installed shall be capped.

B. Prior to capping, all interior duct surfaces shall be wiped clean.

3.4 HANGING:

A. Hanging and support systems shall be in accordance with SMACNA Duct Construction Standards and drawing details.

B. Vertical ducts shall be supported by extending bracing angles to rest firmly on floors or shall be bolted to walls, columns or other construction.

C. Where duct is supported by threaded rods, see Mechanical Sound, Vibration, and Seismic Control specifications for threaded rod requirements and attachment requirements.

D. Where duct is supported by sheetmetal straps, the strap shall attach to the duct with two #10 sheetmetal screws located within 2 inches of the top of the duct.

3.5 ACCESSORIES:

A. Doors, dampers, registers, grilles, diffusers and other accessory items shall be installed as detailed in the SMACNA Duct Construction Standard with adequate reinforcement and support to accommodate additional weight without damage to the duct.

3.6 COMPLETION AND DEMONSTRATION:

A. Upon completion of the duct system installation, and before the A/E has inspected the system operation, open all system dampers and turn on fans to blow all scraps and other loose material out of the duct system. Allow for a means of removal of such material.

B. Check the duct system to ensure there are no excessive air leaks through joints, at reinforcement locations, seams, points of connection with fire dampers, coils, or other duct accessories. Where there are unacceptable leaks, the leakage shall be repaired and shall be done so in a manner of a new installed system. Excessive air leaks shall be leaks that exceed industry standards, cause higher than acceptable noise, or where leakage exceeds reasonable expectations.

END OF SECTION 233112

SECTION 233113.1 - METAL DUCT

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
   1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of all metal duct where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
   1. Section 233112 - Mechanical Duct

1.3 QUALITY ASSURANCE:

A. Codes and Standards: All work shall meet or exceed the standards and procedures (latest editions) of the following:
   1. ASTM A527 Galvanized Steel Spiral Lock Seam Duct
   2. Underwriter Laboratories, UL 103
   3. ANSI Z223.1
   4. NFPA 96

B. Material shall be free from blisters or other mechanical defects. Material shall be galvanized prime sheet steel unless noted otherwise.

C. Sheet metal thickness, cross joints, seams, slip-connections, cross-breaking, bracings, duct supports and reinforcing shall be in accordance with the more stringent requirements of ASHRAE Guide and SMACNA Duct Construction Manual for system pressure classifications. Minimum gauge thickness is 26 unless thicker gauges are indicated.

D. Grease duct doors shall be UL 1978 listed.

E. Manufacturers:
   1. The following round duct manufacturers are acceptable:
      a. United McGill
      b. Semco
      c. Turnkey Duct Systems
      d. Eastern Sheet Metal
      e. Lindab
      f. Hamlin
      g. BHV Sheet Metal Fabricators
      h. Spiral Pipe of Texas

i. Patton Industries

PART 2 - PRODUCTS

2.1 GENERAL:

A. Materials:
1. Duct shall be galvanized or as indicated elsewhere on the plans or in these specifications.
2. Plenums, collars, flashing, etc. located on roofs, exterior of the building, or other locations where exposed to the weather shall be stainless steel.
3. The dryer vent system located outdoors shall be stainless steel.
4. The fume hood exhaust duct shall be stainless steel.
5. The kiln exhaust duct located outdoors shall be stainless steel.

B. Closure:
1. Transverse joints and seams in sheet metal duct shall be of the types and sizes recommended by SMACNA and the ASHRAE Handbook for the specific duct pressure classification.

2.2 ROUND AND FLAT OVAL DUCT (SINGLE WALL SUPPLY):

A. Duct:
1. Duct shall be constructed with spiral lockseams or spiral lock seam/standing rib.

B. Fittings:
1. All fittings are to have continuous welds along all seams. All divided flow fittings are to be manufactured as separate fittings, not as saddle taps, tap collars, or similar duct components.
2. All 90 degree tees and 45 degree laterals (wyes) up to and including 12 inch diameter size shall have a conical entrance into the fitting, produced by machine or press forming. The entrance shall be free of weld build-up, burrs, or irregularities.
3. Elbows in diameters 3 inches through 12 inches shall be two section stamped elbows. All other elbows shall be gored construction with all seams continuous welded. Elbows shall be fabricated to a center-line radius of 1.5 times the cross-section diameter.
4. Pipe to pipe joints in diameters to 50 inches are by the use of sleeve couplings, reinforced by rolled beads.
5. Pipe-to-fitting joints in diameters to 50 inches are by slip fit of projecting collar of the fitting into the pipe. Insertion length of sleeve coupling and fitting collar is 2 inches for diameters through 9 inches and 4 inches for diameters 10 inches and up.

2.3 LOW PRESSURE RUNOUTS:

A. Where concealed low pressure runout ducts are indicated, they may be snap lock duct provided all of the following conditions are met:
1. Ducts 12" round or 12" x 12" and smaller.
2. Runout to a single air distribution device.

3. Less than 15 feet in length.
4. No other specific type of duct is specified.
5. Duct shall be 26 gauge minimum.
6. Snap lock duct free area is equal to or greater than duct specified.
7. Duct does not run through a wall or partition.

PART 3 - EXECUTION

3.1 SUBMITTALS:

A. Provide a list of all duct materials and systems in which they are to be installed for the entire project.

END OF SECTION 233113.1

SECTION 233313 - DAMPERS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Furnish all labor, materials, and perform all operations in connection with the installation of dampers and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

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

B. All sections of Division 23 Specifications apply to this section. In addition, refer to these specification sections:

1. Section 233112 - Mechanical Duct

1.3 QUALITY ASSURANCE:

A. Codes and Standards:
1. Dampers and appurtenances shall be fabricated and installed in accordance with the manufacturer's recommendations and meet or exceed the standards and procedures (latest editions) of the following:
   a. UL Standard 555, 555S (smoke), and 555C (ceilings)
   b. NFPA 90A
   c. AMCA Standard 500
   d. SMACNA Standards

B. Manufacturers:
1. The following balancing damper manufacturers are acceptable:
   a. Ruskin
   b. Air Balance, Inc.
   c. Nailor-Hart
   d. Louvers and Dampers, Inc.
   e. NCA
   f. Airline Products
   g. Arrow
   h. Leader Industries
   i. Pottorff
   j. United Enertech

PART 2 - PRODUCTS

2.1 BALANCING DAMPERS:

A. General:
1. Bolts, screws or rivets shall not be used in construction of damper assembly.
2. Damper shall be opposed blade for dampers 14 inches and higher.
3. Bearings shall be non-corrosive, non-stick type and shall be molded synthetic Cycoloy 800, stainless steel, or Zytel.
4. Damper manufacturer shall provide a complete damper assembly including linkage for connection to actuator, mullions, and jack shafts.
5. All dampers with shafts extending through the ducts with exterior insulation shall have 2 inch standoff brackets or shaft extensions.

B. Materials:
1. Dampers material shall match the duct material in which it is installed unless noted or specified otherwise.

C. Manual Dampers:
1. Low Pressure (Rectangular):
a. Frame shall be 5" x 1" x 16 gage galvanized steel channel. Blades shall be 8" wide, maximum, 16 gage galvanized steel.
b. Dampers 36" W x 12" H and smaller shall have a frame 3" x 22 gauge and 22 gauge blades.
c. Basis of design manual balance dampers manufacturer:
1) Ruskin MD15
2. Low Pressure (Round):
a. Frame shall be 20 gage galvanized steel, 7 inches in length, minimum. Blades shall be 20 gage.
b. Maximum velocity shall be 1500 FPM.
c. This damper shall not be required in flex runouts except where concealed regulators required.
d. Basis of design low pressure manual balancing damper (round) manufacturer:
1) Ruskin MDRS25

PART 3 - EXECUTION

3.1 SUBMITTALS:

A. Fire and Smoke Dampers:
1. Indicate system static pressure and damper dynamic rating (static pressure and airflow) for airflow direction required.

3.2 BALANCEDAMPERS:

A. General:
1. Dampers shall be installed with blades horizontal unless shown otherwise on drawings. Manufacturer shall provide proper damper for installation in non-horizontal ducts.
2. Dampers shall be installed square and without racking. Damper installations shall not allow twisting, torquing or distortion. Provide proper clearances for operation of damper blades.

B. Installation:
   1. Multiple damper sections shall be braced at every horizontal mullion and braced 8 feet O.C., maximum, vertically.
   2. Damper actuator shall be installed on duct or fixed structure. Mounting on gypsum walls or similar structures is not permitted.
   3. Join multiple damper assemblies or fasten damper to duct with Number 10 screws, or 1/2" long welds staggered on both sides 8" on center and maximum of 2" from damper corner or end of joining section. Screws shall not impede performance of glade of blade seals.

C. Sealants:
   1. Low leakage dampers shall have an 1/8" bead of sealant between duct and damper.
   2. Multiple low leakage damper sections shall be sealed with 1/8" bead of sealant applied on all mullion joints and between damper sections.
   3. Sealants shall be:
      a. Dow-Corning 100% Silicon Rubber
      b. Dow-Corning Silastic 732
      c. GE RTV 108

END OF SECTION 233313

SECTION 233346 - FLEXIBLE DUCT

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of all flexible duct where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
1. Section 233112 - Mechanical Duct

1.3 QUALITY ASSURANCE:

A. Codes and Standards:
1. All flexible duct shall comply with all local codes and ordinances, and meet or exceed the standards and procedures (latest editions) of the following:
a. NFPA 90A and 90B
b. Air Diffusion Council test code FD72-R1
c. Underwriters Laboratories, Class 1, Air Duct Standard 181
d. SMACNA
2. Duct shall be suitable for temperatures up to 180 degrees F.

B. Manufacturers:
1. The following flexible air duct (standard grade duct) manufacturers are acceptable:
a. Flex Master
b. Thermaflex
c. Approved equal

PART 2 - PRODUCTS

2.1 GENERAL:

A. Outer jacket shall be fiberglass scrim reinforced metallized film laminate.

B. Insulation R value shall not be less than the duct insulation in the duct to which the flex duct is connected to, but in no case shall the R value be less than 6.0 BTU/hr. sq. ft/degrees F at 70°F. Duct in attics or other unconditioned spaces shall have a minimum R value of 8.0 BTU/hr. sq. ft/degrees F at 70°F.

C. Vapor barrier permanence shall be .1 perm per ASTM Method E96.

D. Inner liner shall be an encapsulated steel spring helix or mechanically fastened to the steel spring helix.

2.2 FLEXIBLE AIR DUCT (STANDARD GRADE DUCT):

A. Inner liner shall be chlorinated polyethylene (CPE) or polyester.

B. Duct shall be suitable for temperatures up to 250 degrees F (continuous), 4000 FPM, +6" W.G. for up to 16" duct and -1/2" W.G. for up to 16" duct.

C. Duct shall be provided at:
1. All flex duct locations except those where medium velocity flex duct specified or indicated on plans.

D. Basis of design duct shall be (metallic jacket):
1. Thermaflex M-KE

2.3 SUPPORTS:

A. Hanger or support saddle shall be provided by the duct manufacturer.

B. Support shall prevent any restriction of the internal diameter of the duct when the weight of the supported section rests on the hanger or saddle material.

C. Minimum width of support shall be 1½" or as required by SMACNA or ADC, whichever is greater.

D. Factory installed suspension systems integral to the flexible duct are an acceptable alternative hanging method when manufacturers' recommended procedures are followed.

2.4 DUCT LENGTHS:

A. The runout length to air distribution units shall be 15 feet maximum unless noted otherwise.

2.5 CONNECTIONS:

A. Tapes shall be listed and labeled in accordance with UL 181B and shall be marked 181B-FX or 181B-M.

B. Non-metallic clamps shall be listed and labeled in accordance with UL 181B and shall be marked UL181B-C.

C. Straps shall be metal for all systems where the duct is required to meet or exceed 2" WC or where located above gypsum, plaster, or other inaccessible ceilings.

D. Metal straps shall be used when connected to a device in a rated assembly.

2.6 ACOUSTICAL PERFORMANCE:

A. All standard grade flexible ducts shall have acoustical properties for ducts as follows:
1. The minimum insertion loss (dB) of a 10 foot length of straight duct at 2500 FPM:

	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
8 inch	10	21	26	30	35	22
12 inch	10	26	26	34	27	14

2. Other size ducts shall have construction equal to and acoustical properties similar to that shown for 8" and 12" duct.

PART 3 - EXECUTION

3.1 GENERAL:

A. Flexible duct shall be supported at manufacturer's recommended intervals but at no greater distance than five (5) feet. Maximum permissible sag is 1/2 inch per foot of spacing between supports.

B. Hangers shall be adequately attached to the building structure.

C. Take every precaution to avoid tearing of vapor barrier. Damage to vapor barrier may be repaired with approved tape. If internal core is penetrated, replace flexible duct.

D. No splicing of flexible duct shall be permitted. All runs must be continuous.

E. Bends shall not be made with centerline radius less than one duct diameter.

F. Do not install flexible duct adjacent to any equipment, piping, etc. which operates above the recommended flexible duct use temperature.

G. Flexible duct shall not be installed through any partition.

3.2 ATTACHING FLEXIBLE DUCT:

A. Collars to which flexible duct is attached shall be a minimum of 2 inches in length.

B. Peel the vapor barrier back 3 or 4 inches. Fold the insulation back over the vapor barrier.

C. Trim duct ends squarely.

D. Tape duct to sleeve or collar.

E. Replace insulation and vapor barrier. Tape to provide vapor seal and protect cover. Seal flexible duct with mastic. Connect with locking strap.

F. Slide inner core of each flexible duct section over sheet metal sleeve one-half the length of sleeve.

G. Protect flexible duct at connections to sleeves or collars by allowing duct to extend straight for a few inches beyond the end of the sheet metal connector before making a bend.

3.3 INSTALLATION INSPECTION:

A. The contractor shall review all flex duct installed when the system is operating at maximum airflow to verify no significant duct leakage at any flexible duct connection.

B. If any leakage is found, the connection shall be repaired.

3.4 INSTALLATION:

A. Where practical, flex duct shall be installed a minimum of 6 feet downstream of air handling equipment.

END OF SECTION 233346

SECTION 233400 - HVAC FANS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of fans and air handling equipment and appurtenances where shown on the drawing and specified hereinafter.

B. Description:
1. Fans (General Purpose) include low pressure equipment designed to handle relatively small amounts (less than several thousand CFM). This equipment is typically located on roof curbs, in walls or ceilings, or in small duct systems.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
1. Section 230502 - Common HVAC Materials

1.3 QUALITY ASSURANCE:

A. Codes and Standards:
1. All work shall meet or exceed the standards and procedures of the following as referenced (latest editions):
a. AMCA 300 - Certified Ratings for Sound and Airflow
b. AMCA 210 - Test Code for Air Moving Devices
c. Insulation - NFPA 90A and UL 181
d. NFPA 96
e. UL762 Outdoor - Power Ventilation for Restaurant Exhaust Appliances.
f. UL705 (Single width backward inclined fans).

B. Manufacturers:
1. The following fan (general purpose) manufacturers are acceptable:
a. Greenheck
b. Cook
c. Acme
d. Penn Ventilator
e. Jenn Aire
f. Twin City Fans
g. Captive Aire
h. Breidert

PART 2 - PRODUCTS

2.1 MOTORS:

A. All motors are premium efficiency.

B. Motors controlled by variable frequency drives shall be inverter duty rated.

C. Where ECM motors are specified to be controlled by the building automation system. The ECM controller shall be controlled by a 0-10 VDC input (or any other input signal coordinated with the control contractor).

D. Where ECM motors are specified strictly to manually balance the fan airflow, the motor shall be provided with a manual speed controller.

2.2 FANS (GENERAL PURPOSE):

A. General:
1. All units shall be licensed to bear the AMCA Certified Ratings Seal for sound and air flow.
2. Fan wheel and shaft shall be statically and dynamically balanced by the fan manufacturer.
3. Fan RPM, tip speed, and motor horsepower shall not exceed that specified or shown on the drawings.
4. Exhaust fans shall be furnished with automatic backdraft dampers unless a motorized damper is indicated.
5. Supply fans shall be furnished with motorized dampers.
6. Conduit chase thru curb cap shall be provided on roof mounted equipment.
7. Fan shall not be selected at more than 85% of maximum pressure obtainable with that fan at the specified CFM.

B. Bearings:
1. Equip all fans with antifriction ball or spherical roller, self aligning, pillow block bearings.
2. Bearings shall be in a cast iron housing and shall be regreaseable.
3. Bearings shall have a minimum life (AFBMA-L50) of 200,000 hours operation at maximum cataloged operating conditions.

C. Roof Mounted Exhaust Fans:
1. Roof exhaust fans shall be centrifugal blower type. Construction of fan housing shall be heavy gauge spun aluminum mounted upon a rigid support. The fan inlet shall have a spun venturi throat overlapped by a backward curved centrifugal wheel with spun cone for maximum performance.
2. The motor shall be mounted on vibration isolators and shall be completely sealed from the exhausted air and fumes.
3. The motor cooling air shall be taken into the chamber from a location free of discharge contaminates.
4. The entire drive assembly and wheel, as a unit, shall be removable thru the support structure without dismantling the fan housing.
5. Pulleys shall be fully machined cast iron type keyed to the wheel and motor shafts.

PART 3 - EXECUTION

3.1 FANS:

A. Fans shall be controlled as shown on schedules and in the SEQUENCE OF OPERATIONS FOR HVAC CONTROLS specification.

B. After testing and balancing has been performed, provide a second drive and set of belts as recommended by the Test and Balance Agency to meet design conditions.

END OF SECTION 233400

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:
   1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of air distribution equipment and appurtenances where shown on the drawing and specified hereinafter.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:
   1. All work shall meet or exceed the standards and procedures of the following as referenced (latest editions):
      a. AMCA 300 - Certified Ratings for Sound and Airflow
      b. AMCA 210 - Test Code for Air Moving Devices
      c. Insulation - NFPA 90A and UL 181
      d. NAAMM Metal Finishes Manual

B. Manufacturers:
   1. The following air distribution manufacturers are acceptable:
      a. Krueger
      b. Metal Aire
      c. J and J Register
      d. Titus
      e. Carnes
      f. Tuttle and Bailey
      g. E.H. Price
      h. Nailor

PART 2 - PRODUCTS

2.1 AIR DISTRIBUTION UNITS (GENERAL):

A. General:

1. Furnish and install where shown on the plans, air distribution units in accordance with the air distribution schedules on the drawings and as specified hereinafter.
2. Return air and exhaust air units in same space with supply shall match supply in style and type.
3. All supply, return, and exhaust air units shall be provided with opposed blade volume damper. Where return grilles are not ducted, the damper may be omitted.
4. Provide round to square adapter for flex duct connecting to square neck.
5. All supply air distribution units not installed in return air stream shall have factory installed insulation with FSK vapor barrier on all surfaces above conditioned space. Insulation shall be 1-1/2" minimum and all edges sealed with duct tape to the grille.

B. Material:
1. General purpose use: steel or aluminum unless other material indicated.
2. Shower areas, drying areas, lockers, janitor rooms, group toilets, kitchens, mechanical spaces, utility spaces, and similar spaces subject to high humidity: aluminum.
3. Fire rated assemblies: steel.
4. Special applications as noted or indicated on schedules.

C. Finish:
1. All air distribution units shall be furnished with manufacturer's standard off-white baked enamel finish unless specifically noted otherwise on plans or in specifications.
2. Finish on bar grilles shall be (anodized aluminum) (dark bronze) (white) unless specifically noted otherwise on plans or in specifications.

D. Frame Style:
1. Frame style shall be suitable for surface in which air distribution unit is to be installed. Manufacturers or contractor shall provide all accessories such as plaster rings, etc., as necessary for a complete, finished installation.
2. Air distribution units shall typically be supplied with frame style as follows:
   a. Units installed in sheetrock, plaster, or other hard finish shall have surface mounted frame style or plaster rings.
   b. Units installed in acoustical ceilings shall have frame style to match ceiling system type.

2.2 ACOUSTICAL CEILING UNITS (LOUVERED FACE):

A. Acoustical ceiling air distribution units shall have a louvered face with frame style compatible with ceiling type. Throw shall be 4 way unless other throws indicated.

B. Surface mounted units shall have a panel face equal or less than the duct connection dimension plus 7".

C. Lay-in ceiling units shall be nominal 24" x 24" unless specified otherwise.

D. Faceplate shall be removable from the frame with concealed hinges and latches.

2.3 HARD OR MONOLITHIC CEILING UNITS (LOUVERED FACE):

A. Hard or monolithic ceiling air distribution units shall have a louvered face as scheduled with surface mount frame style. Throw shall be 4 way unless other throws indicated.

B. Surface mounted units shall have maximum dimensions as follows:
1. Space required for installation - maximum of duct connection dimension plus 4".
2. Panel face - maximum of duct connection dimension plus 7".

C. Faceplates shall be removable from frame with concealed hinges and latches.

PART 3 - EXECUTION

3.1 AIR DISTRIBUTION UNIT:

A. See DAMPERS specifications for additional requirements.

B. Add mastic to duct tape on insulated grilles.

END OF SECTION 233713