Marion County

OREGON

BUSINESS SERVICES DEPARTMENT

Facilities Management Division

PROJECT MANUAL

Marion County Work Release Center
HVAC Replacement

December 05, 2014

100% Bid Set Documents

Revised January 05, 2015

PROJECT LOCATION:
3950 Aumsville Hwy SE, Salem, Oregon

PROJECT REPRESENTATIVES:
Marion County Business Services - Facilities Management
555 Court Street NE, Room 4250
Salem, OR 97301

Architect/Engineer: SOLARC Engineering and Energy+Architectural Consulting
Represented by: Galen Ohmart, AIA 503-223-5253 galen@solarc-ae.net

Facilities Program Manager: Larry Tilford 503-576-7164 ltilford@co.marion.or.us

SECTION 00 0110

TABLE OF CONTENTS

END OF TABLE OF CONTENTS

SECTION 01 0100

SUMMARY OF WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Owner furnished products.

B. Contractor use of site and premises.

C. Working Hours.

D. Work Sequence.

E. Owner occupancy.

1.02 RELATED SECTIONS

A. Section 01 5000 - Construction Facilities and Temporary Controls.

B. Marion County General Conditions: Administration of Contract and Schedule of Work.

1.03 SUMMARY OF WORK

A. Marion County intends to award a contract to the qualified low bidder for the Marion County Work Release Center HVAC Replacement at the existing Work Release Center located at 3950 Aumsville Hwy SE, Salem, OR 97317.

B. Work under this contract will include:

1. Replacement of entire hydronic portion of HVAC system with a new VRF system; providing a new gas-fired commercial condensing type water heater for the domestic hot water system; limited modification of air side of HVAC system to accommodate new VRF system (most ductwork to remain), as shown on the drawings and specified herein, at the existing building and site.

C. The work on this project is primarily HVAC work, and therefore, a General Contractor or HVAC Contractor may perform as General Contractor and coordinate all trades necessary to complete the project in its entirety.

D. Work shall be started within fifteen (15) calendar days after signing of an Agreement with the Owner. The Agreement may not be signed prior to approval of the Contractor's Certificate of Insurance by the Owner. The project shall be completed within the calendar day time frame indicated by the Contractor on the Bid Form.

E. Items noted 'NIC' (Not in Contract), will be furnished and installed by Owner after the Contractor has completed the Work.

F. Marion County will pay for permit fees. Contractor is responsible for picking up all required permits necessary to complete this project from the City of Salem Permit Office and shall have copies on the job site at all times during the project. Contractor is also responsible for submitting all deferred submittals to the City of Salem Permit Office including, but not limited to, mechanical equipment cut sheets, seismic restraint calculations, and roof curb engineering.

1. The contractor is responsible for all fines, or other ramifications for not complying with this instruction.

1.04 CONTRACTOR USE OF SITE AND PREMISES

A. Limit use of site and premises to allow:

1. Owner occupancy and use of the site while construction is occurring. The Owner will also occupy the building and conduct business activities within it and on the adjacent grounds during construction.

B. Access to Site: Limit movement on and off the site for work as indicated on the Drawings or as agreed to with Owner's Project Manager.

C. Construction Operations: Limited to areas noted on Drawings; coordinate additional needs with the Owner's Project Manager. The Contractor shall not damage existing vegetation unless noted for work on the drawings. The Contractor shall not damage: existing building components

not indicated for work in this project, utility lines, or electrical service lines unless noted for work on the drawings.

1. In the event the Contractor damages existing building components or existing utility services the Contractor will, at the Owner's discretion, replace/repair the damaged materials or be assessed a charge by the Owner for such damages.
2. In the event damage occurs to an underground system as a direct result of a Contractor's activities, the Contractor shall repair/replace or be assessed a charge at the discretion of the Owner. If repairs are to be made by the Contractor, such repairs shall be inspected by the Owner's Project Manager or the Owner's agent prior to backfilling. Any galvanized pipe that requires repair shall be repaired at a threaded coupling, not by use of a compression coupling.

D. The Contractor shall protect sidewalks, asphalt paving, concrete, trees, shrubs, and lawn areas at all times from spillage of materials used in carrying out the work. Prevent materials from clogging catch basins and yard drains; leave drains clean and in proper working conditions at all times.

1. In the event the Contractor damages plant material with equipment or personnel, the Contractor will, at the Owner's discretion, replace/repair the damaged materials or be assessed a charge by the Owner for such damages.

E. Parking or Driving on Lawn Areas: The Owner forbids parking or driving on all lawn areas.

1. When it becomes necessary, in accordance with the scope of work, to traverse a lawn area, the Contractor shall place plywood on the area to be driven on. The plywood shall be of sufficient thickness and width to support vehicles and prevent rutting of the lawns. Care shall also be taken with respect to existing lawn sprinkler heads (if any).

F. Utility Outages and Shutdown: Inform the Owner's Project Manager 72 hours prior to any utility outages or shutdowns which will affect the existing building.

1.05 WORKING HOURS

A. The Owner will allow construction work to occur during hours the building is open to the public; 8:00 a.m. to 5:00 p.m. Monday through Friday. Coordination of access to the building after hours, weekends, and holidays must be arranged with the Owner's Project Manager in advance.

1.06 ASBESTOS AND OTHER HAZARDOUS MATERIAL

A. If during the course of the Contract, the Contractor observes or suspects the existence of hazardous materials in the structure, components of the building, or site the Contractor shall immediately stop work and notify the Owner's Project Manager. The Owner will arrange for the removal of hazardous materials as required by Owner personnel or by separate contract. Should hazardous materials be found in the area of work the Contractor will be required to schedule ten (10) days of slack or "down" time for the removal of hazardous materials without penalty to the Owner for the delay of the Contract.

1.07 WORK SEQUENCE

A. Construct Work using methods, techniques, and scheduling advantageous to swift completion. Review proposed sequence and scheduling with the Owner's Project Manager for approval prior to commencing work.

1.08 OWNER OCCUPANCY OF SITE

A. The Owner will occupy and use the building and site of work while construction is occurring. Contractor shall coordinate work so that public use of the site is not hazardous to the public or to the renovation and remodeling work.

B. Cooperate with Owner to minimize conflict, provide safety provisions, and cooperate to facilitate Owner's operations.

C. Schedule the Work to accommodate this requirement.

1.09 EXISTING CONDITIONS AND DIMENSIONS

A. Field verify existing conditions prior to bid opening. Request clarification from the Owner's Project Manager for conditions found that are in conflict with information shown on the drawings or specified prior to bid opening.

B. Field verify existing dimensions/measurements prior to bid opening. Do not scale measurements or dimensions from the Drawings. Bid errors resulting from scaled measurements and/or dimensions shall be solely the responsibility of the Bidder.

C. Field verify dimensions of new openings, new construction, and new equipment/devices prior to ordering any material components subject to field dimensions. Successful bidder is responsible for dimensions which shall be confirmed and correlated at the project site for compatibility with project components.

D. Project components ordered or obtained for incorporation with the work that are not compatible with verified dimensions shall be solely the responsibility of the successful Bidder.

E. Field verify existing structure materials prior to bid opening. Request clarification from the Owner's Project Manager for materials found that are in conflict with information shown on the drawings or specified prior to bid opening. Bid errors resulting from failure to field verify existing structure materials shall be solely the responsibility of the Bidder.

1.10 INFEASIBLE WORK

A. If work is required in a manner to make it impossible to produce first class work or should discrepancies appear among Contract Documents, make a written request for interpretation before proceeding with Work. If Contractor fails to make such written request, no excuse will there-after be entertained for failure to carry out work in satisfactory manner.

B. If work is shown in the Contract Documents that is not possible to complete, or deletion/addition of work in one area makes it impossible or infeasible to complete work in another area, make a written request for interpretation before proceeding with further work. If Contractor fails to make such written request, no excuse will thereafter be entertained for failure to carry out work in satisfactory manner.

C. Means and methods of construction are solely the responsibility of the Contractor. Bidding means and methods that are deemed infeasible by site conditions, other than concealed conditions, shall be the sole responsibility of the Contractor. The Owner shall not compensate the Contractor for changes to means and methods determined infeasible by existing site conditions, other than concealed conditions.

1.11 COMPUTER AIDED DRAFTING (CAD) DRAWINGS

A. CAD files of the Contract Drawings are available from the Architect for use by the Contractor in the execution of Work, or for reproduction for their purposes of this project only under the following provisions:
   1. Contractor to Pay The Architect the cost of reproduction and electronic media.
   2. Drawings are in AUTOCAD format. Architect makes no representation as to the compatibility of the CAD drawings/files with any hardware or software.
   3. All information on the CAD drawings/files is considered instruments of service of the Architect and shall not be used for other projects, for additions or modifications to this project, or completion of this project by others. CAD files remain the property of the Architect and in no case is the transfer of these files a sale.
   4. Architect makes no representation regarding the accuracy, completeness, or permanence of the CAD files, nor for fitness for any purpose whatsoever. The files do not represent a Contract.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 0270

APPLICATIONS FOR PAYMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Required Schedule of Values submittal.

B. Procedures for preparation and submittal of Applications for Payment.

1.02 RELATED SECTIONS

A. Marion County Public Improvement Agreement: Contract Sum/Price and alternate prices and time schedule for submittals.

B. Marion County General Conditions: Progress Payments and Final Payment.

C. Section 01 02 80 - Change Order Procedures: Procedures for changes to the Work.

D. Section 01 30 00 - Submittals: Submittal procedures.

E. Section 01 70 00 - Contract Closeout: Final Payment.

1.03 SCHEDULE OF VALUES

A. WITHIN TEN (10) CALENDAR DAYS prior to submission of the first application for progress payment, submit to the Owner's Project Manager a Schedule of Values for the Project. Prepare Schedule of Values using standard format and procedures provided in Marion County General Conditions for Public Improvement Contracts.

1.04 FORMAT

A. AIA G702 - Application and Certificate for Payment including continuation sheets when required.

B. For each item, provide a column for listing: Item Number; Description of Work; Scheduled Value, Previous Applications: Work in Place and Stored Materials under this Application: Authorized Change Orders; Total Completed and Stored to Date of Application; Percentage of Completion; Balance to Finish; and Retainage.

1.05 PREPARATION OF APPLICATIONS

A. Present required information in typewritten form or on electronic media printout.

B. Execute certification by signature of authorized officer.

C. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of Work performed and for stored products.

D. List each authorized Change Order as an extension on continuation sheet, listing Change Order number and dollar amount as for an original item of Work.

E. Include Federal Tax Identification Number on all submitted Contract Payment Request forms.

F. Prepare Application for Final Payment as specified in Section 01 70 00.

1.06 SUBMITTAL PROCEDURES

A. Submit THREE copies of each Application for Payment, EACH COPY WITH ORIGINAL SIGNATURE(S) and EACH COPY NOTARIZED.

B. PAYMENT PERIOD:

1. Payment Period: The Owner shall make progress payments, per Marion County Public Improvement Agreement and Marion County General Conditions for Public Improvement Contracts, on the account of the Contract once monthly for the duration of the project (i.e. four (4) payments on a four-month project), based on the value of work accomplished or materials on the job-site, as stated in the schedule of values on the Application and Certificate for Payment. Retainage, in amount specified in the Agreement and General Conditions, to be calculated into the Application for Payment. Complete Application and Certificate for Payment and forward to the Owner via the Owner's Project Manager on or about the 25th day of each month. A progress payment shall not be considered acceptance or approval of any Work or waiver of any defects therein.

2. Contractor shall submit applications to the Owner's Project Manager for each payment and, if required, receipts or other vouchers showing payments for materials and labor including payments to Subcontractors. Payments will be made on protected materials on hand at the job site properly stored, protected, and insured. Estimated quantities shall be subject to the Owner's Project Manager's review and judgement. Contractor shall include, in the application for payment, a schedule of the percentages of the various parts of the Work completed, based on the Schedule of Values which shall aggregate to the payment application total.
3. SUBMIT PAYROLL WAGE RATE CERTIFICATES WITH EACH APPLICATION FOR PAYMENT AND FOR THE SAME PERIOD OF TIME AS THE APPLICATION FOR PAYMENT.

1.07 EARLY PURCHASE AND PAYMENT OF MATERIALS AND EQUIPMENT

A. Order materials and equipment requiring a long lead or waiting time early so as not to delay progress of the Work.

B. The Contractor will be reimbursed for early order of materials or items, in accordance with Marion County Public Improvement Agreement Form and Marion County General Conditions for Public Improvement Contracts, upon receipt and verification of quality and quantity against submittals and shipping documents by the Contracting Officer's Representative. Receipt shall be to the job site, stored at the Owner's premises or at a location off site approved by the Owner's Project Manager that is properly bonded and insured. Early order material to be stored in an orderly and safe manner, secured from weather damage. Security remains the responsibility of the Contractor.

1.08 SUBSTANTIATING DATA

A. When the Owner's Project Manager requests substantiating information, submit data justifying dollar amounts in question. Data shall include a breakdown of dollar amounts by labor, material, profit & overhead. Failure to do so will delay payment of any portion of the pay request.

B. Provide one copy of data with cover letter for each copy of submittal. Show Application number and date, and line item by number and description.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 0280

CHANGE ORDER PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. Documentation of change in Contract Sum/Price and Contract Time.

C. Change procedures.

D. Construction Change Directive.

E. Stipulated Sum change order.

F. Execution of change orders.

G. Correlation of Contractor submittals.

H. Percentage allowances for Contractor’s overhead and profit.

1.02 RELATED SECTIONS

A. Marion County Public Improvement Agreement: Standard Form of Agreement for Construction.

B. Marion County General Conditions for Public Improvement Contracts: Administration of the Contract, including requirements for changes in the Work, in Contract Sum/Price, and Contract Time.

C. Marion County General Conditions for Public Improvement Contracts: Percentage allowances for Contractor's overhead and profit.

D. Section 01 02 70 - Applications for Payment: Procedure for including authorized Change Orders in payment application.

E. Section 01 30 00 - Submittals: Work schedule.

F. Section 01 30 00 - Submittals: Schedule of values.

G. Section 01 60 00 - Material and Equipment: Product options and substitutions.

H. Section 01 70 00 - Contract Closeout: Project record documents.

1.03 SUBMITTALS

A. Submit name of the individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

B. Change Order Forms: AIA G701 Change Order including continuation sheets when required.

1.04 DOCUMENTATION OF CHANGE IN CONTRACT SUM/PRICE AND CONTRACT TIME

A. Maintain detailed records of work done. Provide full information required for evaluation of proposed changes, and to substantiate costs of changes in the Work.

B. Document each quotation for a change in cost or time with sufficient data to allow evaluation of the quotation.

C. Provide data to support computations:
   1. Quantities of products, labor, and equipment.
   2. Taxes, insurance, and bonds.
   3. Overhead and profit.
   4. Justification for any change in Contract Time.
   5. Credit for deletions from Contract, similarly documented.

1.05 CHANGE PROCEDURES

A. The Owner’s Project Manager will advise of minor changes in the Work not involving an adjustment to Contract Sum/Price or Contract Time as authorized by the General Conditions, by issuing Supplemental Instructions.

B. The Owner's Project Manager may issue a Proposal Request which includes a detailed description of a proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change and the period of time during which the requested price will be considered valid. Contractor will prepare and submit an estimate within thirty (30) calendar days.

C. The Contractor may propose a change by submitting a request for change to the Owner's Project Manager, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum/Price and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested in accordance with Section 016000.

1.06 CONSTRUCTION CHANGE DIRECTIVE

A. Owner's Project Manager may issue a document instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

B. The document will describe changes in the Work, and will designate method of determining any change in Contract Sum/Price or Contract Time.

C. Promptly execute the change in Work.

D. A Construction Change Directive will be issued by the Owner's Project Manager, per the General Conditions, if necessary to enact Change Order work.

1.07 STIPULATED SUM CHANGE ORDER

A. Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for a Change Order as approved by Owner's Project Manager. Documentation will be prepared by the Owner's Project Manager in accordance with the Marion County Public Improvement Agreement Form.

B. Hourly labor rates submitted by the Contractor shall indicate a breakdown of each rate according to wages, benefits, profit, and overhead.

1.08 EXECUTION OF CHANGE ORDERS

A. Execution of Change Orders: Owner's Project Manager will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

1.09 CORRELATION OF CONTRACTOR SUBMITTALS

A. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum/Price.

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

C. Promptly enter changes in Project Record Documents.

1.10 PERCENTAGE ALLOWANCES

A. The maximum allowance for overhead and profit combined, included in the total cost to the Owner, shall be based on the Marion County Public Improvement Agreement Form and Marion County General Conditions for Public Improvement Contracts.

B. BOND AND INSURANCE COSTS ATTRIBUTED TO A CHANGE IN THE CONTRACT SUM AND/OR SCOPE OF WORK SHALL BE INCLUDED AS A PART OF THE PERCENTAGES INDICATED ABOVE AS MAXIMUM ALLOWANCE FOR PROFIT AND OVERHEAD.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 0410

PROJECT COORDINATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Construction mobilization.

B. Project security requirements.

C. Schedules/sequencing/phased Work.

D. Submittals.

E. Project progress meetings.

F. Closeout procedures.

1.02 RELATED SECTIONS

A. General Conditions For Construction Project: Preconstruction conference.

B. Section 01 0100 - Summary of Work: Work sequence and Owner occupancy.

C. Section 01 7000 - Contract Closeout: Contract closeout procedures.

1.03 CONSTRUCTION MOBILIZATION

A. Pre-Job Meeting (Mandatory):

1. A pre-job meeting will be conducted at the job site prior to start up. The selected Contractor shall notify all parties involved with project, including sub-contractors, Owner's representative, City of Salem Fire Marshal, and City of Salem Building Inspector, a minimum of eight (8) working days prior to the scheduled meeting.
2. Meeting will not be conducted until all applicable submittal requirements are met and approved.

B. Cooperate with the Owner’s Project Manager in allocation of mobilization area for site; for field offices and sheds, for building access/security, traffic, and parking facilities. See SUMMARY OF WORK, Section 01 0100, and CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS, Section 01 5000, and drawings for additional information.

C. During construction coordinate use of the site, existing building, and any other facilities with the Owner’s Project Manager.

D. Comply with the instructions of the Owner’s Project Manager for the use of temporary utilities and construction facilities.

E. Comply with Owner’s Project Manager procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

1.04 SECURITY

A. Marion County Security requires a criminal background check of all contractors, workers and helpers on projects associated with Marion County Buildings. No person with a felony conviction appearing on their record or as deemed as a security risk by any of the regulating authorities will be allowed to work on this project.

B. Contractor shall fill out background information form supplied by Facilities Management and have it signed and notarized.

C. A list of all on-site employees is required to be submitted prior to an employee being on the job-site. This list must be updated immediately and prior to any new employees working on the site.

1. This requirement applies to all sub-contractors and anyone else that the General Contractor requires during the entire course of the project.

D. Any keys or access cards issued to authorized construction personnel for after hour work are to be used for the sole purpose of accessing the project site for execution of the project work. No

authorized construction personnel shall unlock doors to allow any other person into the project site.

1.05 HIGH SECURITY ISSUES (CORRECTIONS AND DETENTION AREAS)

A. Security Clothing: All persons working on the project shall be dressed in approved clothing.
   1. This is a secured jail facility and all on-site contractor personnel shall have reflective vest or approved colored shirt and other required identification.
   2. Color and/or Style requirements shall be discussed at the pre-bid meeting.

B. Contractor shall comply with ALL Owner's requirements for staging, access, and work area notifications, without exception during the entire project.
   1. Special notifications are required at certain specific high security areas prior to working in that area.
   2. A minimum of 24 hours' notice and approval is required BEFORE working in high security areas.

C. The Contractor shall provide access to the County of all equipment and materials located on site for Security Inspection by the County Staff at any time during this project. Also, the Contractor and all workers completing work required by this contract must submit to a search if required by the County. This is a mandatory requirement for this project in order to ensure the safety of the staff who work for the County in this Facility.

D. The County has the right to prevent any worker of the Contractor or their subcontractors from working on site, as they deem necessary, to protect the security of the facility

E. Contractor shall be responsible for the protection and safekeeping of products stored on the site under this Contract.

F. Secure Institution: All blades, cutting utensils, and materials capable of use as a sharp instrument will be strictly accounted according to County Sheriff's office protocol.

1.06 SCHEDULES

A. The work in the Project Scope is to be completed in phases in order to facilitate movement of occupants out of areas of work to Owner designated locations. Refer to Sheets A003 and A004 for proposed construction duration per phase.

B. Submit preliminary progress schedule, Work sequencing, and phased Work plan in accordance with Sections 01 3000 and 01 3100.

C. After review by the Owner's Project Manager revise and resubmit schedule to comply with revised Project schedule.

D. Contractor shall provide a crew large enough to complete the project in a timely manner and stay within submitted and approved schedule.

E. During progress of Work, revise and resubmit schedule with Applications for Payment.

1.07 SUBMITTALS

A. Submit shop drawings, product data and samples in accordance with Section 01 3000 for review and compliance with Contract Documents, for field dimensions and clearances, for relation to available space, and for relation to Work of separate contracts. Revise and resubmit as required.

B. FAILURE TO SUBMIT SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES AS SPECIFIED HEREIN SHALL RESULT IN WITHHOLDING OF A PORTION OF THE CONTRACT SUM TO ACCOUNT FOR FAILURE TO FULFILL CONTRACT OBLIGATIONS.

C. Submit AIA G702, including continuation sheets when required, to the Owner.

D. Submit requests for interpretation of Contract Documents, and obtain instructions from the Owner's Project Manager.

E. Process requests for substitutions, and change orders, through the Owner's Project Manager.

F. Deliver closeout submittals for review and preliminary inspection reports to the Owner's Project Manager.

1.08 COMPUTER AIDED DRAFTING (CAD) DRAWINGS

A. CAD files of the Contract Drawings are available from the Architect for use by the Contractor in the execution of Work, or for reproduction for the purposes of this project only under the following provisions:
   1. Contractor to Pay The Architect the cost of reproduction and electronic media.
   2. Drawings are in AUTOCAD format. Architect makes no representation as to the compatibility of the CAD drawings/files with any hardware or software.
   3. All information on the CAD drawings/files is considered instruments of service of the Architect and shall not be used for other projects, for additions or modifications to this project, or completion of this project by others. CAD files remain the property of the Architect and in no case is the transfer of these files a sale.
   4. Architect makes no representation regarding the accuracy, completeness, or permanence of the CAD files, nor for fitness for any purpose whatsoever. The files do not represent a Contract.

1.09 PROJECT PROGRESS MEETINGS

A. Project progress meetings will be scheduled and required on a regular basis at a mutually agreed time, place, and day. Meetings will be attended by the Contractor and Owner's Project Manager.

B. Project progress meetings may be canceled on a case by case basis as mutually agreed by the Contractor and Owner's Project Manager.

1.10 CLOSEOUT PROCEDURES

A. Notify the Owner's Project Manager IN WRITING when Work is considered ready for Substantial Completion.

B. Comply with Owner's Project Manager instructions to correct items of Work listed in executed Certificates of Substantial Completion.

C. Notify the Owner's Project Manager IN WRITING when Work is considered finally complete.

D. Comply with instructions for completion of items of Work determined by the Owner's Project Manager final inspection.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 0450

CUTTING AND PATCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED SECTIONS

A. Marion County General Conditions: Job Site Conditions.

B. Section 01 01 00 - Summary of Work.

C. Section 01 30 00 - Submittals.

D. Section 01 60 00 - Materials and Equipment: Product Options and Substitutions.

E. Individual Product Specification Sections:
   1. Cutting and patching incidental to Work of the Section.
   2. Advance notification to other Sections of openings required in Work of those Sections.
   3. Limitations on cutting structural members.

1.03 SUBMITTALS

A. Submit written request in advance of cutting or alteration which affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather-exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.

B. Include in request:
   1. Identification of Project.
   2. Location and description of affected Work.
   3. Necessity for cutting or alteration.
   4. Description of proposed Work, and products to be used.
   5. Alternatives to cutting and patching.
   6. Effect on Work of Owner or separate contractor.
   7. Written permission of affected separate contractor.
   8. Date and time Work will be executed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Primary Products: Those required for original installation.

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

PART 3 EXECUTION

3.01 EXAMINATION

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

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

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

D. DO NOT CUT ANY JOIST, HEADER, RAFTER, BEAM, COLUMN OR ANY OTHER STRUCTURAL MEMBER, UNLESS SPECIFICALLY INDICATED ON THE DRAWINGS, WITHOUT PRIOR APPROVAL OF THE OWNER'S PROJECT MANAGER.

E. OBTAIN WRITTEN APPROVAL FROM OWNER'S PROJECT MANAGER PRIOR TO DRILLING HOLES IN WALLS, ROOFS OR CEILINGS

3.02 PREPARATION

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

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

C. Maintain excavations free of water.

3.03 CUTTING AND PATCHING

A. Execute cutting, fitting, and patching including excavation and fill, if any, to complete Work.

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

C. Uncover Work to install improperly sequenced Work.

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

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

3.04 PERFORMANCE

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

B. Employ original installer or equally qualified person as original installer to perform cutting and patching for weather exposed and moisture resistant elements, and sight-exposed surfaces.

C. Cut rigid materials using appropriate means for the type of material. Protect surroundings and clean up all debris, including dust. Pneumatic tools not allowed without prior approval.

D. Restore Work with new products in accordance with requirements of Contract Documents.

E. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces. Provide sealant or fire rated sealant at penetrations through surfaces for pipes, sleeves, ducts, conduit, or any other penetrations.

F. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material that maintains fire rating integrity of penetrated component.

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

END OF SECTION

SECTION 01 0900

REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reference Standards applicable to this project.

1.02 QUALITY ASSURANCE

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

B. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.03 REFERENCED STANDARDS

A. General Applicability:
   1. Unless otherwise shown referenced items without listed date shown are latest issue.
   2. Published standards for materials and operations specified by reference require compliance.
   3. In case of conflict between referenced standards and project specifications, project specifications govern.
   4. Except to extent of more explicit stringent requirements written directly into Contract Documents, or are required by governing regulations, applicable standards of construction industry have same force and effect for Work (and are made a part of Contract Documents by reference) as if copied directly into contract documents or as if published copies are bound herein.
   5. Referenced standards take preference over standards that are not referenced but recognized in construction industry as applicable.
   6. Where an industry standard compliance is required, standard in effect as of date of Contract Documents applies, unless shown otherwise.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 1200

ALTERATION PROJECT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Products and installation for patching and extending Work.

B. Transition and adjustments.

C. Repair of damaged surfaces, finishes, and cleaning.

D. Procedure for addressing hazardous materials.

1.02 RELATED SECTIONS

A. Marion County General Conditions: Administration of the Contract and Job Site Conditions.

B. Section 01 04 10 - Project Coordination: Work scheduling, sequence, and phases.

C. Section 01 04 50 - Cutting and Patching: Cutting and patching.

PART 2 PRODUCTS

2.01 PRODUCTS FOR PATCHING AND EXTENDING WORK

A. New Materials: As specified in product Sections; match existing Products and Work for patching and extending Work.

B. Type and Quality of Existing Products: Determine by inspection and testing Products where necessary, referring to existing Work as a standard.

2.02 RE-USE OF EXISTING MATERIALS AND PRODUCTS

A. Unless otherwise noted on drawings do not re-use existing materials or products for patching and extending Work; do not re-use existing equipment unless noted on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that demolition is complete, and areas are ready for installation of new Work.

B. Beginning of remodeling/alteration Work means acceptance of existing conditions.

3.02 PREPARATION

A. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion all previously cut, moved, or removed items.

B. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete, notifying Owner’s Project Manager prior to removal for inspection and approval.

C. Remove debris and abandoned items from areas of work and from concealed spaces.

D. Prepare surface and remove surface finishes to provide for proper installation of new Work and finishes.

E. Close openings in exterior and/or interior surfaces to protect existing Work from weather and extremes of temperature and humidity. Insulate duct Work and piping to prevent condensation in exposed areas.

3.03 INSTALLATION

A. Coordinate Work of alterations and renovations to expedite completion, to accommodate Owner occupancy, and minimize disruption of existing building ingress and egress.

B. Designated areas, Rooms and spaces and Finishes: Complete in all respects including operational mechanical, electrical, and plumbing Work.

C. Remove, cut, and patch Work in a manner to minimize damage and to provide a means of restoring Products and finishes to original or specified condition.

D. Refinish visible existing surfaces to remain in renovated rooms and spaces, to original or specified condition for each material, and original relationship to adjacent finishes.

E. In addition to specified replacement or removal of equipment and fixtures, restore existing plumbing, heating, ventilation, air conditioning, electrical, security systems, fire sprinkler, landscape, and all areas affected by work to full operational condition.

F. Install Products as specified in individual Sections.

3.04 TRANSITIONS

A. Where new Work abuts or aligns with existing, perform a smooth and even transition. Patched Work to match existing adjacent Work in texture and appearance.

B. When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation and get approval by the Owner's Project Manager.

3.05 ADJUSTMENTS

A. Where a change of plane of 1/4 inch or more occurs, request instructions from Owner's Project Manager.

B. Fit Work at penetrations of surfaces as specified in Section 01 04 50.

3.06 REPAIR OF DAMAGED SURFACES

A. Patch or replace portions of existing surfaces affected by work area which are damaged, lifted, discolored, or showing other imperfections.

B. Repair substrate prior to patching finish.

3.07 FINISHES

A. Finish surfaces as specified in individual Product Sections.

B. Finish patches to product uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.08 HAZARDOUS MATERIALS

A. Hazardous materials such as asbestos, asbestos products, polychlorinated biphenyl (PCB) or other toxic substances shall not be allowed on the site nor be used in the Work. The Contractor shall notify the Owner's Project Manager immediately and stop Work in the area affected if any one of the products or materials specified in the Contract Documents or proposed by the Contractor or subcontractors or material suppliers or encountered on the job site contain or are suspected to contain hazardous materials in any form, so that a qualified consultant retained by the Owner can determine whether such materials may be used in the Work or need to be removed from the site or rendered harmless in a manner which will not adversely affect the health of any person and which will comply with applicable governmental laws and regulations. Work in the affected area shall be resumed in the absence of any hazardous materials or when it has been rendered harmless by written agreement between Contractor and Owner.

3.09 CLEANING

A. In addition to cleaning specified in Section 01 70 00, clean Owner occupied areas of Work at the end of each working day per Section 01 50 00.

END OF SECTION

SECTION 01 2000

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cash allowances.

B. Contingency allowances.

C. Schedule of values.

D. Applications for payment.

E. Change procedures.

F. Defect assessment.

G. Unit prices.

H. Alternates.

1.02 RELATED SECTIONS

A. Marion County General Conditions: Payments.

1.03 CASH ALLOWANCES

A. Costs Included in Cash Allowances: Cost of product to Contractor or Subcontractor, labor for installation and finishing; less applicable trade discounts; and delivery to site.

B. Costs Not Included in Cash Allowances But Included in Contract Sum/Price: Product delivery to site and handling at site, including unloading, uncrating, and storage; and protection of products from elements and from damage.

C. Owner's Project Manager Responsibilities:
   1. Consult with Contractor for consideration and selection of products, suppliers, and installers.
   2. Select products in consultation with Owner and transmit decision to Contractor.
   3. Prepare Change Order.

D. Contractor Responsibilities:
   1. Assist Owner's Project Manager in selection of products, suppliers and installers.
   2. Obtain proposals from suppliers and installers and offer recommendations.
   3. On notification of selection by Owner's Project Manager, execute purchase agreement with designated supplier and installer.
   4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
   5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.

E. Differences in costs will be adjusted by Change Order.

1.04 SCHEDULE OF VALUES

A. Submit printed schedule on AIA Form G703 - Continuation Sheet for G702.

B. Submit Schedule of Values in duplicate within 10 calendar days after date of Notice to Proceed per Marion County Public Improvement Agreement Form and Marion County General Conditions for Public Improvement Contracts.

C. Format: Utilize Table of Contents of this Project Manual. Identify each line item with number and title of major specification Section. Identify site mobilization, bonds and insurance, and all other General Conditions costs.

D. Include in each line item, amount of Allowances specified in this section. [For unit cost Allowances, identify quantities taken from Contract Documents multiplied by unit cost to achieve total for each item.]

E. Include separately from each line item, direct proportional amount of Contractor's overhead and profit.

F. Revise schedule to list approved Change Orders, with each Application for Payment.

1.05 APPLICATIONS FOR PAYMENT

A. See specification section 01 02 70.

B. Substantiating Data: When Owner's Project Manager requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
   1. Current construction photographs specified in Section 01 38 00.
   2. Partial release of liens from major subcontractors and vendors.
   3. Record documents as specified in Section 01 70 00, for review by Owner which will be returned to Contractor.
   4. Affidavits attesting to on-site stored products.
   5. Affidavits attesting to off-site stored products.
   6. Construction progress schedules, revised and current as specified in Section 01 31 00.

1.06 CHANGE PROCEDURES

A. See specification section 01 02 80.

B. Contractor may propose changes by submitting a request for change to Owner's Project Manager, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. Document requested substitutions in accordance with Section 01 60 00.

C. Change Order Forms: as used by the Owner's Project Manager.

D. Execution of Change Orders: Owner's Project Manager will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

E. Correlation Of Contractor Submittals:
   1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
   2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
   3. Promptly enter changes in Project Record Documents.

1.07 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the Owner's Project Manager, it is not practical to remove and replace the Work, the Architect will direct appropriate remedy or lower payment

C. The defective Work may remain, but Contract sum/price will be adjusted to new lower Contract sum/price at discretion of Owner's Project Manager.

D. Defective Work may be partially repaired to instructions of Owner's Project Manager, and Contract sum/price will be adjusted to new lower Contract sum/price at discretion of Architect.

E. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.

F. Authority of Owner's Project Manager to assess defects and identify payment adjustments, is final.

G. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from transporting vehicle.
   4. Products placed beyond lines and levels of required Work.
   5. Products remaining on hand after completion of the Work.

6. Loading, hauling, and disposing of rejected products.

1.08 UNIT PRICES (IF ANY)

A. Authority: Measurement methods are delineated in individual specification sections.

B. Measurement methods delineated in individual specification sections complement criteria of this section. In event of conflict, requirements of individual specification section govern.

C. Take measurements and compute quantities. Owner's Project Manager will verify measurements and quantities.

D. Unit Quantities: Quantities and measurements indicated in Bid Form (IF ANY) are for contract purposes only. Quantities and measurements supplied or placed in the Work shall determine payment. Actual quantities provided shall determine payment.
   1. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at unit sum/prices contracted.
   2. When actual Work requires 10 percent or greater change in quantity than those quantities indicated, Owner or Contractor may claim for Contract Price adjustment.

E. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application or installation of item of the Work; overhead and profit.

F. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Owner's Project Manager multiplied by unit sum/price for Work incorporated in or made necessary by the Work.

PART 2 PRODUCTS

2.01 NOT USED.

PART 3 EXECUTION

3.01 NOT USED.

END OF SECTION

SECTION 01 2300

ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submission procedures.

B. Documentation of changes to Contract Sum/Price and Contract Time.

1.02 RELATED SECTIONS

A. Bid Form: Requirements for Alternates.

B. Marion County General Conditions: Incorporating monetary value of accepted Alternates.

C. Section 01 3000 - Submittals: Work schedule affected by Alternates.

D. Section 01 6400 - Substitution and Product Options: Product options and substitutions.

1.03 DESCRIPTION

A. The Alternates described in this Section may be exercised at the option of the Owner with the Execution of the Owner/Contractor Agreement.

B. It is generally the practice of the Owner to exercise Alternates in numerical order as indicated in the Inivitation to Bid (ITB). However, the Owner reserves the right to accept Alternates without regard to order or sequence; but, such acceptance shall not impair the selection of a low, responsible, and responsive bidder to whom the Contract may be awarded under an equitable bid procedure.

1.04 REQUIREMENTS

A. Alternates quoted on Bid Form will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.05 QUALITY ASSURANCE

A. For each Alternate which is accepted, coordinate the work of the various trades involved, and modify surrounding work as required to complete the Project as intended.

B. In the change-in-price figure for each Alternate, include incidental costs which are attributable to adjustments in the work of other trades which may be required to achieve the contemplated and final conditions.

C. If there is a question regarding the extent, scope, nature, or intent of the Alternates, contact the Owner’s Project Manager for clarification. Failure on the part of the Contractor to clarify any unclear items shall not relieve the Contractor of the responsibility for performing the selected Alternates in accordance with the intent and requirements of the Project Manual and Drawings.

D. The description of the Alternates hereinafter is qualitative and not quantitative. The Contractor shall determine the quantities of labor and materials and the extent of same required to execute the selected Alternates in accordance with the intent and requirements of the Project Manual and Drawings.

1.06 SELECTION AND AWARD OF ALTERNATIVES

A. Alternate bids shall be ADDITIVE sums and work to the base bid work and sum.

B. The Owner shall select those alternate bids which best serves the Owner's interests and construction budget.

C. Owner reserves the right to execute an alternate bid any time following award of the base contract and up to just prior the date of substantial completion.

PART 2 PRODUCTS

2.01 APPLICATION OF PROJECT DOCUMENTS TO ALTERNATES

A. The applicable Sections of the Specifications and information on the Drawings apply to the work under each Alternate.

PART 3 EXECUTION

3.01 SCHEDULE OF ALTERNATES

A. Verify additive alternate bids (if any) with Owner's Project Manager. See bid form and drawings.

B. Owner reserves the right to add alternates during the bidding proces

C. Schedule of alternates:

1. Alternate #1: Drain and remove entirely existing condenser piping and related components above ceiling serving removed units, with as little disruption to building operations as possible, in lieu of draining and abandoning in place as per Base Bid. See bid form, drawings, schedules, and specifications.

END OF SECTION

SECTION 01 3000

SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittal procedures.

B. Construction progress schedules.

C. Proposed products list.

D. Shop drawings.

E. Product data.

F. Samples.

G. Manufacturers' instructions.

H. Manufacturers' certificates.

1.02 RELATED SECTIONS

A. Marion County General Conditions: Contract Closeout

B. Section 01 4000 - Quality Control: Manufacturers' field services and reports.

C. Section 01 7000 - Contract Closeout: Contract warranty and manufacturer's certificates closeout submittals.

1.03 SUBMITTAL PROCEDURES

A. Transmit each submittal with Owner’s Project Manager accepted form.

B. Electronic submission of submittals to Architect and Owner's Project Manager via e-mail is preferred. In the case of samples, or submittals for which an electronic copy is not obtainable, submit minimum quantity of copies of submittals in accordance with Marion County Public Improvement Agreement Form and Marion County General Conditions for Public Improvement Contracts PLUS AS MANY ADDITIONAL COPIES WHICH WILL BE RETURNED TO THE CONTRACTOR; minimum three copies of submittals will be retained by the Owner’s Project Manager.

C. Identify Project, Contractor, Subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.

D. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.

E. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.

F. Provide space for Contractor and Owner’s Project Manager review stamps.

G. Revise and resubmit submittals as required, identify all changes made since previous submittal.

H. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.04 CONSTRUCTION PROGRESS SCHEDULES

A. SUBMIT INITIAL PROGRESS SCHEDULE IN ACCORDANCE WITH MARION COUNTY PUBLIC IMPROVEMENT AGREEMENT FORM AND MARION COUNTY GENERAL CONDITIONS FOR PUBLIC IMPROVEMENT CONTRACT IN TRIPLICATE WITHIN FIFTEEN (15) CALENDAR DAYS AFTER DATE OF NOTICE TO PROCEED FOR OWNER’S PROJECT MANAGER REVIEW.

B. Revise and resubmit as required or requested.

C. Submit Progress Schedule in format specified in Section 01 3100 and/or as indicated below.

D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities.

E. Indicate estimated percentage of completion for each item of Work at each submission.

F. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.

1.05 PROPOSED PRODUCTS LIST

A. WITHIN REASONABLE PROMPTNESS, AFTER DATE OF NOTICE TO PROCEED, PER MARION COUNTY PUBLIC IMPROVEMENT AGREEMENT FORM AND MARION COUNTY GENERAL CONDITIONS FOR PUBLIC IMPROVEMENT CONTRACT, SUBMIT COMPLETE LIST OF MAJOR PRODUCTS PROPOSED FOR USE, WITH NAME OF MANUFACTURER, TRADE NAME, AND MODEL NUMBER OF EACH PRODUCT.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.06 SHOP DRAWINGS

A. Submit the number of opaque reproductions which Contractor requires in accordance with Marion County Public Improvement Agreement and Marion County General Conditions for Public Improvement Contract, PLUS THREE COPIES WHICH WILL BE RETAINED BY THE OWNER'S PROJECT MANAGER.

B. After review distribute in accordance with Article on Procedures above and for Record Documents described in Section 01 7000 - Contract Closeout.

1.07 PRODUCT DATA

A. Submit the number of copies which the Contractor requires, PLUS THREE COPIES WHICH WILL BE RETAINED BY THE OWNER'S PROJECT MANAGER.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.

C. After review, distribute in accordance with Article on Procedures above and provide copies for Record Documents described in Section 01 7000 - Contract Closeout.

1.08 SAMPLES

A. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing Work.

B. Submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Owner's Project Manager selection.

C. Include identification on each sample, with full Project information.

D. Submit the number of samples specified in individual specification Sections; TWO of which will be retained by Owner's Project Manager. If number of samples are not indicated in individual specification Sections submit minimum of THREE; two of which will be retained by Owner's Project Manager.

E. Reviewed samples which may be used in the Work are indicated in individual specification Sections.

1.09 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.

B. Identify conflicts between manufacturers' instructions and Contract Documents.

1.10 MANUFACTURER'S CERTIFICATES

A. When specified in individual specification Sections, submit manufacturers' certificate to Owner's Project Manager for review, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Owner's Project Manager.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 3100

PROGRESS SCHEDULES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Format.

B. Content.

C. Revisions to schedules.

D. Submittals.

1.02 RELATED SECTIONS

A. Marion County General Conditions: Administration of the Contract and Schedule of Work.

B. Section 01 01 00 - Summary of Work: Owner occupancy.

C. Section 01 04 10 - Project Coordination: Schedules/sequencing/phased Work.

D. Section 01 30 00 - Submittals: Construction Progress Schedules.

E. Section 01 30 00 - Submittals: Shop drawings.

1.03 FORMAT

A. Prepare schedules as a horizontal bar chart with separate bar for each major portion of Work or operation, identifying first work day of each week.

B. Sequence of Listings: The chronological order of the start of each item of Work.

C. Scale and Spacing: To provide space for notations and revisions.

D. Sheet Size: Minimum 11 x 17 inches.

E. Quantity: Three (3)

1.04 CONTENT

A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

B. Identify each item by specification section number.

C. Identify Work of separate stages and other logically grouped activities.

D. Provide sub-schedules to define critical portions of the entire schedule.

E. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

F. Provide separate schedule of submittal dates for shop drawings, product data, and samples, including Owner furnished products, and dates reviewed submittals will be required from the Owner's Project Manager. Indicate decision dates for selection of finishes.

G. Indicate delivery dates for Owner furnished products, if any.

1.05 REVISIONS TO SCHEDULES

A. Indicate progress of each activity to date of submittal, and projected completion date of each activity.

B. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.

C. Provide narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect.

1.06 SUBMITTALS

A. Submit initial schedule(s) in accordance with Marion County Public Improvement Agreement and Marion County General Conditions for Public Improvement Contract within fifteen (15)

calendar days after date of Notice to Proceed. After review, resubmit required revised data within seven calendar days.

B. Submit revised Progress Schedules at each job site meeting with the Owner's Project Manager that occur at the start of each calendar month.

C. Submit three opaque reproductions of the Progress Schedule to the Owner's Project Manager.

1.07 DISTRIBUTION

A. Distribute copies of reviewed schedules to Project site file, Subcontractors, suppliers, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules. Submit copy of recipients response to the Owner's Project Manager.

PART 2 PRODUCTS

2.01 NOT USED.

PART 3 EXECUTION

3.01 NOT USED.

END OF SECTION

SECTION 01 3800

CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Photography.

B. Digital Files.

C. Technique.

D. Submittals.

1.02 RELATED SECTIONS

A. General Conditions and applicable Supplementary Conditions: Dates for applications for payment.

B. Section 01 01 00 - Summary of Work: Stages of the Work.

C. Section 01 70 00 - Contract Closeout: Project record documents.

1.03 PHOTOGRAPHY

A. Provide photographs of site and construction throughout progress of Work produced by a photographer acceptable to the Owner's Project Manager.

B. Take photographs during the course of construction to record progress and uncovered conditions to document for the Owner's Project Manager as follows:
   1. Demolition.
   2. Existing utilities uncovered during course of the Work.
   3. Damaged existing construction and damage caused during new work.
   4. Bench marks, reference points, and construction layout.
   5. New construction during the course of the Work.
   6. Final completion.

C. Take photographs as evidence of existing project conditions. Report any existing conditions of consequence to the Owner's Project Manager prior to undertaking the Work.

D. Schedule photographs of site and construction on a minimum weekly basis.

1.04 DIGITAL FILES

A. Original full color, high resolution, .JPG or .TIF format files.

B. Color photocopies are not acceptable.

C. Identify date of photo (year-month-day format xxxx-xx-xx), abbreviated name of project, photographer's numbered identification of exposure, and subject (if applicable) in file name.

1.05 TECHNIQUE

A. Provide factual presentation.

B. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

1.06 VIEWS

A. Consult with Architect and Owner's Project Manager for instructions on views required.

1.07 SUBMITTALS

A. Deliver digital files within three days after exposure via e-mail to Architect and Owner's Project Manager with transmittal letter specified under Section 01 30 00.

B. Name all files with date and subject.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 4000

QUALITY CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Quality assurance and control of installation.

B. References.

C. Field samples.

D. Manufacturers' field services and reports.

E. Correlation and Intent of Contract Documents.

F. Code requirements.

G. Existing conditions and dimensions.

H. Guarantee of Work.

1.02 RELATED SECTIONS

A. Section 01 0100 - Summary of Work.

B. Section 01 0900 - Reference Standards.

C. Section 01 3000 - Submittals: Submission of Manufacturers' Instructions and Certificates.

D. Section 01 6000 - Material and Equipment: Requirements for material and product quality.

1.03 QUALITY ASSURANCE/CONTROL OF INSTALLATION

A. Unless otherwise specified, perform the Work using workers skilled in the particular type of work involved.

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

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

D. Should manufacturers' instructions conflict with Contract Documents, request clarification from Owner’s Project Manager before proceeding.

E. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

F. Perform Work by persons qualified to produce workmanship of specified quality.

G. Should the Owner’s Project Manager, in writing, deem anyone on the Work incompetent or unfit for the assigned duties, dismiss the worker immediately or re-assign the worker to a different task requiring a lesser degree of competence.

H. Work shall be first class in every respect and all Work performed shall be according to the best trade practices.

I. The Contractor shall maintain effective supervision on the project at all times Work is being performed. The Superintendent shall be the same person throughout the project AND SHALL ATTEND THE PRECONSTRUCTION CONFERENCE.

J. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

K. Unless specified and/or noted otherwise materials and products indicated/specified shall be new; re-use of existing materials and products must be specifically allowed by notation in the Contract Documents. Used materials and products are not allowed unless specified and/or noted otherwise.

1.04 REFERENCES

A. Conform to reference standard edition that is current on date of Contract Documents

B. Obtain copies of standards when required by Contract Documents.

C. Should specified reference standards conflict with Contract Documents, request clarification from Owner's Project Manager before proceeding.

D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.05 FIELD SAMPLES

A. Install field samples at the site as required by individual specifications Sections for review.

B. Acceptable samples represent a quality level for the Work.

C. Where field sample is specified in individual Sections to be removed, clear area after field sample has been accepted by Owner's Project Manager.

1.06 MANUFACTURERS' FIELD SERVICES AND REPORTS

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

B. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

C. Submit report in duplicate within thirty (30) days of observation to the Owner's Project Manager for review.

1.07 CORRELATION AND INTENT OF CONTRACT DOCUMENTS

A. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferrible from them as being necessary to produce the intended results.

B. Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. THE ARCHITECT WILL NOT ADVISE THE CONTRACTOR AS TO SUBCONTRACTOR WORK RESPONSIBILITY.

C. The General Contractor and all Sub-Contractors shall examine all portions of the Contract Documents as they form the Contract for Construction. Neither the Owner or the Architect will be responsible for use by the Contractor or Sub-Contractors of partial or incomplete sets of documents.

1.08 CODE REQUIREMENTS

A. Construction of this project shall be under jurisdiction and codes of the City of Salem, Marion County, State of Oregon Department of Commerce, the Oregon State Fire Marshal's Rules and Regulations, and the requirements of the National Electrical Code, International Building Code, and International Fire Code. Contractor shall comply with requirements of latest edition of each listed above.

B. Comply with Oregon Department of Environmental Quality rules, regulations, and requirements for handling and disposal of hazardous materials.

1.09 EXISTING CONDITIONS AND DIMENSIONS

A. Field verify existing conditions prior to bid opening. Request clarification from the Owner's Project Manager for conditions found that are in conflict with information shown on the drawings or specified prior to bid opening.

B. Field verify existing dimensions/measurements prior to bid opening. Do not scale measurements or dimensions from the Drawings. Bid errors resulting from scaled measurements & dimensions shall be solely the responsibility of the Bidder.

C. Field verify dimensions of new openings, new construction, and new equipment/devices prior to ordering any material components subject to field dimensions. Successful bidder is responsible for dimensions which shall be confirmed and correlated at the project site for compatibility with project components.

D. Project components ordered or obtained for incorporation with the work that are not compatible with verifiable dimensions shall be solely the responsibility of the successful Bidder.

1.10 INFEASIBLE WORK

A. If work is required in a manner to make it impossible to produce first class work or should discrepancies appear among Contract Documents, make a written request for interpretation to Owner's Project Manager before proceeding with Work. If Contractor fails to make such written request, no excuse will there-after be entertained for failure to carry out work in satisfactory manner.

B. If work is shown in the Contract Documents that is not possible to complete, or deletion/addition of work in one area makes it impossible or infeasible to complete work in another area, make a written request for interpretation to Owner's Project Manager before proceeding with further work. If Contractor fails to make such written request, no excuse will thereafter be entertained for failure to carry out work in satisfactory manner.

C. Means and methods of construction are solely the responsibility of the Contractor. Bidding means and methods that are deemed infeasible by site conditions, other than concealed conditions, shall be the sole responsibility of the Contractor. The Owner shall not compensate the Contractor for changes to means and methods when determined infeasible by site conditions, other than concealed conditions.

1.11 GUARANTEE OF WORK

A. Before final payment is made to the General Contractor, he/she shall furnish a written guarantee to repair or replace any defects caused by faulty workmanship or materials, without additional cost to the Owner. The guarantee shall cover a period of one year from the date of acceptance of the project by the Owner, unless a longer period of coverage is required by the specifications or special provisions.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 5000

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary Utilities: Electricity, lighting, heat, telephone service, water, and sanitary facilities.

B. Temporary Controls: Barriers, enclosures, protection of the Work, and water control.

C. Construction Facilities: Access roads, parking, and progress cleaning.

1.02 RELATED SECTIONS

A. Marion County General Conditions: Job Site Conditions and Contract Closeout.

B. Section 01 0410 - Project Coordination.

C. Section 01 7000 - Contract Closeout: Final cleaning.

1.03 TEMPORARY ELECTRICITY

A. Electrical service for the project limited to 20 amp 120v circuits will be paid for by the Owner. Connection to the service shall be the responsibility of the Contractor, with Owner's approval. Coordinate with Owner's Project Manager.

B. Power consumption by the Contractor shall not disrupt Owner’s need for continuous service. Disruption of Owner’s needs will result in revoking of power consumption privileges from existing service.

C. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required. Cords and branch wiring shall not conflict with pedestrian traffic or building exiting requirements.

1.04 TEMPORARY LIGHTING

A. Provide and maintain incandescent lighting for construction operations.

B. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes.

C. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

D. Maintain lighting and provide routine repairs.

1.05 TEMPORARY HEATING AND COOLING

A. The building will remain occupied during construction. Provide temporary heat, or cooling, to areas served during cutover periods from existing heat pumps to new fan coil units to maintain ambient temperatures between 66F and 74F for occupant comfort during construction.

B. Provide and pay for heating and cooling devices required to maintain specified conditions for construction operations.

1.06 TEMPORARY VENTILATION

A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.07 TELEPHONE SERVICE

A. Provide, maintain, and pay for telephone service to field office at time of project mobilization. Use of the Owner's telephone will not be acceptable.

B. Owner’s telephones shall not be used to make telephone calls.

1.08 TEMPORARY WATER SERVICE

A. Water service in reasonable quantities for the project will be paid for by the Owner. Connection to the services shall be the responsibility of the Contractor, with the Owner's approval. Coordinate with the Owner's Project Manager.

B. Temporary water distribution system shall not conflict with Owner's use existing water service or ingress/egress from the existing building.

C. Extend branch piping with outlets located so water is available by hoses with threaded connections. Prevent water service supply lines from freezing.

1.09 TEMPORARY SANITARY FACILITIES

A. Provide, maintain, and pay for portable/temporary restroom facilities and enclosures for Contractor use at project mobilization. Coordinate location with Owner's Project Manager. Owner's existing restroom facilities may not be used.

1.10 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas and to allow for Owner's use of site adjacent to area of Work, and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide barricades and walkways required by Owner's Project Manager for public rights-of-way and for public access to/from existing buildings and existing parking areas.

C. Protect non-owned vehicles, stored materials, site and structures from damage.

1.11 WATER CONTROL

A. If appropriate, grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water.

C. Protect new construction from storm water drainage damage prior to installation of specified drainage system.

D. Failure to provide water control on site during construction will be solely the Contractor's responsibility.

E. Water damage to the building from construction activities, or from unprotected exterior openings, will be solely the Contractor's responsibility to repair any such damage.

F. When concrete/masonry saw cutting is a part of the project, protect all existing spaces and surfaces from water and debris damage. Control and clean up water used for cutting and debris to prevent damage.

1.12 EXTERIOR ENCLOSURES

A. Provide temporary weather-tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating or cooling as needed to maintain ambient temperatures between 66F and 74F for occupant comfort during construction, and to prevent entry by unauthorized persons. Provide access doors with self-closing hardware and locks.

1.13 INTERIOR ENCLOSURES

A. Provide temporary partitions and ceilings as required to separate Work areas from occupied areas, to prevent penetration of dust, fumes, and moisture into completed areas and occupied areas, and to prevent damage to materials and equipment. Coordinate and review temporary interior enclosures with Owner's Project Manager prior to implementation.

1.14 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification Sections.

B. Provide temporary and removable protection for installed Products. Control activity in immediate Work area to minimize damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas whereever possible. If traffic is necessary, protect area using approriate methods, and restore.

1.15 SECURITY

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

1.16 PROGRESS CLEANING

A. Maintain all areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. At the end of each workday, remove all tools, screws, nails, and other hardware from the facility and secure said items so as not to present a safety/security issue.

D. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

E. Remove waste materials, debris, and rubbish from site daily into appropriate container located as specified by Owner's Project Manager and dispose off-site weekly.

1.17 FIELD OFFICES AND SHEDS

A. Office: Weather-tight, with lighting, electrical outlets, heating equipment, and equipped with sturdy furniture.

B. Locate offices and sheds adjacent to construction area; coordinate with Owner and Architect.

1.18 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Do not interrupt any existing service. Prior request and approval of the Owner will enable shutting down any utility required by the Work. Contractor's employees shall not shut down utilities.

B. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.

C. Clean and repair damage caused by installation or use of temporary work. Clean, level, and repair lawn and other landscape damage, including sprinklers, caused by installation or use of temporary work or equipment.

D. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

E. Restore existing utilities disrupted by construction at time of disruption. Contractor shall be responsible for cost of repairing damaged existing utility.

1.19 PROTECTION OF EXISTING SITE AMENITIES

A. Protect sidewalks, asphalt paving, concrete, trees, shrubs, and lawn areas at all times from spillage of materials used in carrying out the Work. Prevent materials from clogging catch basins and yard drains; leave drains clean and in proper working condition.

1. In the event the Contractor damages plant material with equipment or personnel, the Contractor will, at the Owner’s discretion, replace/repair the damaged materials or be assessed a charge by the Owner for the damages.
2. In the event damage occurs to an existing utility system or irrigation system as a direct result of a Contractor's activities, the Contractor shall repair/replace or be assessed a charge at the discretion of the Owner. If repairs are to be made by the Contractor, the repairs will be inspected by the Owner’s Project Manager prior to backfilling. Any galvanized pipe that requires repair shall be repaired at a threaded coupling, not by use of a compression coupling.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 6000

MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Products.

B. Transportation and handling.

C. Storage and protection.

D. Product options.

E. Substitutions.

1.02 RELATED SECTIONS

A. Marion County Invitation to Bid, Section C.1.1 - Points of Contact.

B. Marion County Invitation to Bid, Section C.1.8 - Brand Name Usage.

C. Marion County Invitation to Bid, Section C.2 - Request for Brand Name / Product Substitution.

D. Marion County Invitation to Bid, Section C.4.4 - Contract Forms.

E. Marion County General Conditions: Administration of the Contract and Job Site Conditions.

F. Section 01 0100 - Summary of Work.

G. Section 01 4000 - Quality Control: Product quality monitoring.

1.03 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.

B. Do not re-use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

C. Provide interchangeable components of the same manufacturer, for similar components.

D. All products, as defined above, shall be new, unless noted otherwise in the Contract Documents.

1.04 TRANSPORTATION AND HANDLING

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.05 STORAGE AND PROTECTION

A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weathertight, climate controlled enclosures.

B. For exterior storage of products, place on sloped supports, above ground.

C. Provide off-site storage and protection when site does not permit on-site storage or protection.

D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.

E. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

G. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

H. Make arrangements and coordinate with Owner's Representative all on-site storage activities. Security for on-site stored materials is the responsibility of the Contractor.

1.06 PRODUCT OPTIONS

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

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

1.07 SUBSTITUTIONS

A. Requests for substitution of products in place those specified shall be in accordance with Instructions to Bidders in Invitation to Bid, and as specified herein.

B. Provide same guarantee for accepted substitutions as for products specified.

C. Coordinate installation of accepted substitutions into the Work, making such changes as may be required for the Work to be complete in all respects.

D. Substitution Requirements During the Bidding Period -Submit ONE (1) copy of the following information with each request to the Architect/Engineer:
   1. Substitution Request Form: See Section 01 6410.
   2. Itemized comparison of proposed substitution with product or method specified.
   3. Complete data on each material and system for this project only, substantiating compliance of proposed substitution with the Contract Documents.
   4. Complete evidence, including test numbers and supporting reports, indicating compliance with referenced standards.
   5. A statement from the materials manufacturer stating warrantee requirements specified are acceptable and such a warranty shall be issued upon successful completion of the project.
   6. A set of details for this project clearly indicating specific deviations proposed for the substitution. Copies of the Drawings and Details for this Project shall be used for this purpose. Any and all deviations shall be indicated.
   7. Copies of related specifications sections within the Project Manual clearly marked to indicate all deviations in materials, products, and methods specified. Any and all deviations shall be indicated.
   8. Samples of all materials and products including accessories, anchors, and similar items.

E. ALL SUBSTITUTION REQUESTS SHALL BE RECEIVED IN THE ARCHITECT'S OFFICE NO LESS THAN SEVEN (7) CALENDAR DAYS BEFORE THE BID OPENING DATE. REQUESTS RECEIVED AFTER THIS DATE WILL NOT BE CONSIDERED.

F. SUBMIT ELECTRONIC COPIES BY E-MAIL TO ARCHITECT, WITH A COPY TO OWNER'S PROJECT MANAGER.

1.08 SUBSTITUTIONS FOR VALUE ENGINEERING

A. Substitutions may be considered between when the bid is accepted and when the contract is awarded if value engineering is required to bring the scope of work within the Owner's budget. SUBSTITUTIONS AFTER THE BIDDING PERIOD WILL NOT BE CONSIDERED DUE TO FAILURE OF THE SUBSTITUTION PROPOSER TO COMPLY WITH SUBSTITUTION REQUEST REQUIREMENTS DURING THE BIDDING PERIOD.

1.09 SUBSTITUTIONS AFTER THE AWARD OF CONTRACT

A. Substitutions may be considered after the bidding period when a product becomes unavailable through no fault of the Contractor or other unforseen circumstances. SUBSTITUTIONS AFTER THE BIDDING PERIOD WILL NOT BE CONSIDERED DUE TO FAILURE OF THE SUBSTITUTION PROPOSER TO COMPLY WITH SUBSTITUTION REQUEST REQUIREMENTS DURING THE BIDDING PERIOD.

B. Within a period of thirty (30) days after date of the Contract, the Owner may, at its option, consider formal written requests for substitution of products in place of those specified, when submitted in accordance with the requirements stipulated herein. To receive consideration, one or more of the following conditions must be documented in any such request:
   1. The substitution is required for compliance with final interpretation of code requirements or insurance regulations.
   2. The substitution is required due to unavailability of a specified product, through no fault of the Contractor.
   3. The substitution is required because subsequent information disclosed the inability of the specified product to perform properly or to fit in the designated space.
   4. The substitution is required because it has become clearly evident, in the judgement of the Owner, that a substitute would be substantially in the best interest of the Owner in terms of cost, time, or other considerations.

C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

D. Substitutions may be considered by the Owner at any time when determined that the substitution is required because it has become clearly evident, in the judgement of the Owner, that a substitute would be substantially in the best interest of the Owner in terms of cost, time, or other considerations.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 OWNER'S - EXISTING FURNISHINGS

A. Owner's Responsibilities:
   1. Provide on-site first floor location for furnishings required to be moved.
   2. Remove desk-top equipment, including, computers, monitors and desk-top printers.
   3. Coordinate room vacancy requirements with Contractor
   4. Inspect products jointly with Contractor.
   5. Submit claims for transportation damage

B. Contractor's Responsibilities:
   1. Record existing location of furnishings
   2. Move, handle, store, re-install all furnishing as required to complete the work.
   3. Repair or replace damaged items.

3.02 MOVING AND HANDLING - EXISTING FURNISHINGS AND ON SITE PRE-PURCHASED ITEMS

A. Coordinate the moving schedule of furnishings to designated prepared areas in order to minimize site storage time and potential damage.

B. Protect furnishing to prevent damage.

C. Promptly inspect furnishings to ensure they are undamaged when re-set to previous locations

D. Provide equipment and personnel to handle furnishings by methods to prevent disfigurement, or damage.

3.03 STORAGE, PROTECTION, RE-INSTALLATION - FURNISHINGS

A. Owner will designate first floor storage areas for furnishings so that they can be placed convenient to work area in order to minimize excessive furnishing handling when allowable.

B. Store and protect furnishings.

C. Cover products to protect with impervious sheet covering.

D. Re-install furnishings to original location

END OF SECTION

SECTION 01 6410

SUBSTITUTION REQUEST FORM

TO: SOLARC Engineering and Energy + Architectural Consulting
Attn: Tanesha Hyde: tanesha@solarc-ae.net
CC: Galen Ohmart: galen@solarc-ae.net
CC: Brandon Crossley: bcrossley@co.marion.or.us

PROJECT: Marion County Work Release Center HVAC Replacement
4000 Aumsville Hwy
Salem, Oregon

SPECIFIED ITEM: _____ _____ _____
Section Paragraph Description

The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION:_____

_____

Attached data includes product descriptions, specifications, drawings, photographs, performance and test data adequate for evaluation of request including identification of applicable data portions.

Attached data also includes description of changes to Contract Documents and proposed substitution requires for proper installation.

The undersigned certifies following items, unless modified by attachments, are correct:

1. Proposed substitution does not affect dimensions shown on drawings.
2. Undersigned pays for changes to building design, including engineering design, detailing, and construction costs caused by proposed substitution.
3. Proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.
4. Maintenance and service parts available locally or readily obtainable for proposed substitution.

Undersigned further certifies function, appearance, and quality of proposed substitution are equivalent to or superior to specified item.

Submitted by: _____ Signature: _____ Firm: _____ Address:_____ _____ Date: _____ Tel: _____ Fax: _____ Attachments:_____	For use by Architect / Engineer for recommendation: ☐ Approved ☐ Approved as noted ☐ Not Approved ☐ Received too late By: _____ Date: _____ Comments: _____ _____ For use by Marion County Project Manager for final decision: ☐ Approved ☐ Approved as noted ☐ Not Approved ☐ Received too late By: _____ Date: _____ Comments: _____

SECTION 01 6500

STARTING OF SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Starting systems.

B. Demonstration and instructions.

C. Testing, adjusting, and balancing.

1.02 RELATED SECTIONS

A. Section 01 4000 - Quality Control: Manufacturers field reports.

B. Section 01 7000 - Contract Closeout: System operation and maintenance data and extra materials.

1.03 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Owner’s Project Manager seven days prior to startup of each item.

C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of responsible personnel in accordance with manufacturers' instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report in accordance with Section 01 4000 indicating equipment and/or systems have been properly installed and is/are functioning correctly.

1.04 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of final inspection.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.

D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment.

E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.05 TESTING, ADJUSTING, AND BALANCING

A. Contractor shall employ and pay for services of an independent firm to perform testing, adjusting and balancing.

B. Reports will be submitted by the independent firm to the Owner’s Project Manager indicating observations and results of tests and indicating compliance or non-compliance with specified requirements and with the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 SCHEDULE

A. Start up, adjust, balance, and make operable any and all new or existing (existing affected by the work of this project) systems to a function and condition equal to or better than existed prior to start of construction. All existing equipment and apparatus affected by Work of this project shall perform equal to or better than existed prior to commencement of the project. Contractor shall be responsible for determining operational functionality and condition of each system prior to starting work. Systems and equipment shall include, but are not limited to:
   1. Fire suppression system.
   2. Plumbing and domestic water system.
   3. Natural gas system.
   4. Heating system.
   5. Ventilation system.
   6. Cooling system.
   7. Controls.
   8. HVAC control.
   9. Lighting control.
   10. Lighting.
   11. Electrical system.
   12. Voice/data system.
   13. Security system, including cameras.
   14. Fire alarm system.
   15. Irrigation system.
   16. Landscaping.

END OF SECTION

SECTION 01 7000

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Closeout procedures.

B. Final cleaning.

C. Adjusting.

D. Project record documents.

E. Operation and maintenance data.

F. Warranties.

G. Spare parts and maintenance materials.

1.02 RELATED SECTIONS

A. Marion County General Conditions: Contract Closeout

B. Section 01 4000 - Quality Control: Guarantees and warranties.

C. Section 01 5000 - Construction Facilities and Temporary Controls: Progress cleaning.

1.03 CLOSEOUT PROCEDURES

A. Submit WRITTEN CERTIFICATION that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Owner's Project Manager inspection.

B. Provide submittals to Owner's Project Manager that are required by governing, project funding, or other authorities.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

D. Owner will occupy all of the building as specified in Section 01 0100.

1.04 FINAL REVIEW AND PAYMENT

A. Prior to completion the Contractor shall inspect the Work and make a "punch list" noting all items that are incomplete and/or incorrect.

B. The Contractor shall notify all Subcontractors in writing of incomplete and/or incorrect items. Notify far enough in advance of the Completion Date so Work can be completed on schedule. Said Work shall be immediately corrected.

C. Should conditions prevail which prohibit some elements of the Work from being accomplished, but the work-in-place will perform the primary function (i.e., painting can not be completed due to high moisture content of masonry walls, etc.) the Contractor shall record the reason with this "punch list" item requesting temporary delay in completion from the Owner in writing.

D. Notify the Owner in writing that all items are completed and ready for final review or else that the Work product is fully usable, but some listed deficiencies remain to be completed. Submit all record documents at this time.

E. The Owner will review all documents. When documents include a Contractor's request for delay in completion the Owner will review all Work which is certified as complete to the best knowledge of the Contractor. The Owner will also review the listed incomplete Work and assign a value to such incomplete work.

F. The Contractor shall make the required corrections to the Work expeditiously. Upon Owner occupancy, sufficient retainage monies will be held to pay for incomplete Work, should the Contractor fail to perform. A letter will be addressed to the Contractor informing the Contractor of the project status and the monies available for semi-final payment upon receipt of billing.

G. When Contract closeout procedures are completed and all punch list deficiencies have been corrected, final acceptance by the Owner will be documented. The Contractor will receive

written notice of acceptance of the Work and notification that final payment may be billed and released.

1.05 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Clean glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Clean equipment and fixtures to a sanitary condition.

D. Clean filters of operating equipment.

E. Clean debris from area of Work.

F. Remove all tools, screws, nails, and other hardware from the facility and secure said items so as not to present a safety/security issue.

G. Clean site; sweep existing paved areas where materials have been stored or disposed of.

H. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.06 ADJUSTING

A. Adjust operating Products and Equipment to ensure smooth and unhindered operation.

1.07 PROJECT RECORD DOCUMENTS

A. Maintain on site, three sets of the following record documents; record actual revisions to the Work:
   1. Contract Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other Modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.

B. Store Record Documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and Modifications.

E. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract Drawings.
   6. Per the General Conditions (K.2), provide two 3-ring tabbed binders that lists all items, components, systems and etc., sorted by the most current CSI format. In addition, one (1) CD with all closing documents, all as-builts (in AUTOCAD and PDF), and other O&M information that depict the project as constructed and shall reflect each and every change, modification, and deletion made during the construction.

F. Submit documents to Owner, as part of the Operations and Maintenance Data manual.

1.08 OPERATION AND MAINTENANCE DATA

A. Submit quantity of sets in accordance with Marion County General Conditions for Public Improvement Contracts, including project record documents, upon 75% completion of the Work.

Bind 8-1/2 x 11 inch text pages in three-ring (D-ring) binders with durable plastic covers. Include a digital copy of the material, organized in the same manner as the binder(s).

B. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.

C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified.

E. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.

F. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
   1. Significant design criteria.
   2. List of equipment.
   3. Parts list for each component.
   4. Operating instructions.
   5. Maintenance instructions for equipment & systems.
   6. Maintenance instructions for finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

G. Part 3: Project documents and certificates, including the following:
   1. Shop drawings and product data.
   2. Air and water balance reports.
   3. Certificates.
   4. Photocopies of warranties and bonds.

H. Submit completed volume in accordance with Marion County General Conditions for Public Improvement Contracts, Section K.2, in final form prior to submission of any pay request for more than 75% of the Work. This copy will be reviewed after final inspection with Owner's Project Manager comments as necessary . Revise content of documents as required prior to final submittal.

I. Submit final volumes revised, within ten days after final inspection.

1.09 WARRANTIES

A. Provide duplicate notarized copies. Identify Owner's responsibilities under the terms of the warranties.

B. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.

C. Provide Table of Contents and assemble in three D side ring binder with durable plastic cover.

D. Submit prior to final Application for Payment.

E. All warranties and guaranties shall commence and become effective beginning on the date of Final Acceptance by the Owner.

1.10 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.

B. Deliver to Project site and place in location as directed.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 01 7900

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products and systems

B. Training of Owner personnel in operation and maintenance is required for:
   1. All renovated and upgraded mechanical and electrical systems and equipment.

C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
   1. All renovated and upgraded mechanical and electrical systems and equipment.

1.02 RELATED REQUIREMENTS

A. Marion County General Conditions: Contract Closeout.

B. Section 01 9113 - General Commissioning Requirements: Additional requirements applicable to demonstration and training.

1.03 SUBMITTALS

A. See Section 01 3000 - Submittals for submittal procedures, and Section 01 70 00 - Contract Closeout for closeout procedures

B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit transmittal to Owner.
   2. Submit not less than four weeks prior to start of training.
   3. Revise and resubmit until acceptable.
   4. Provide an overall schedule showing all training sessions.
   5. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Intended audience, such as job description.
      d. Objectives of training and suggested methods of ensuring adequate training.
      e. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      f. Media to be used, such a slides, hand-outs, etc.
      g. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

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

D. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
   1. Format: DVD Disc.
   2. Label each disc and container with session identification and date.
   3. Provide one disk for each set of O&M Manuals. Place in disk holder in front cover.

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.

2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstration may be combined with Owner personnel training if applicable.

C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
   1. Perform demonstrations not less than two weeks prior to Substantial Completion.
   2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
   1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

A. Conduct training on-site unless otherwise indicated.

B. Owner will provide classroom and seating at no cost to Contractor.

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

D. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. The location of the O&M manuals and procedures for use and preservation; backup copies.
   2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   3. Typical uses of the O&M manuals.

E. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
   3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
   4. Provide hands-on training on all operational modes possible and preventive maintenance.
   5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
   6. Discuss common troubleshooting problems and solutions.
   7. Discuss any peculiarities of equipment installation or operation.
   8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
   9. Review recommended tools and spare parts inventory suggestions of manufacturers.
   10. Review spare parts and tools required to be furnished by Contractor.
   11. Review spare parts suppliers and sources and procurement procedures.

F. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 01 91 13

GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE AND DESCRIPTION

A. Commissioning is a systematic process of ensuring that building systems perform interactively according to the design intent and the owner's operational needs. This is achieved by beginning in the design phase and documenting design intent and continuing through construction, acceptance and the warranty period with actual verification of performance. The scope of commissioning for the Marion County Work Release Center HVAC Replacement project shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing.

Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:

1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and that they receive adequate operational checkout by installing contractors.
2. Verify and document proper performance of equipment and systems.

B. Abbreviations. The following are common abbreviations used in the Specifications and in the Commissioning Plan.

1.	A/E-	Architect and design engineers
2.	CA-	Commissioning agent
3.	CC	Controls contractor
4.	CM-	Construction Manager (the owner's representative)
5.	Cx-	Commissioning
6.	Cx Plan-	Commissioning Plan document
7.	EC-	Electrical contractor
8.	FT-	Functional test
9.	GC-	General contractor
10.	MC-	Mechanical contractor
11.	PC-	Prefunctional checklist
12.	Subs-	Subcontractors of any tier
13.	TAB-	Test and balance contractor

C. Definitions

1. Acceptance Phase - phase of construction after startup and initial checkout when functional test, O&M documentation review and training occurs.
2. Approval - acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.
3. Architect / Engineer (A/E) - the prime consultant (architect) and sub-consultants who comprise the design team, generally the HVAC mechanical designer/engineer and the electrical designer/engineer.
4. Basis of Design - The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The basis of design describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of the design intent may be included.
5. Commissioning Agent (CA) - The CA directs and coordinates the day-to-day commissioning activities.
6. Commissioning Plan - an overall plan, developed before or after bidding, that provides the structure, schedule and coordination planning for the commissioning process.

7. Control system - the central building energy management control system.
8. Datalogging - monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control system.
9. Deferred Functional Tests - FTs that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.
10. Deficiency - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).
11. Design Intent - a dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.
12. Design Narrative or Design Documentation - sections of either the Design Intent or Basis of Design.
13. Factory Testing - testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.
14. Functional Completion - A specific time period (days), after Substantial Completion, when all remaining TAB and commissioning responsibilities of the Contractor, (except for seasonal or approved deferred testing and controls training), must be completed or the stipulated liquidated damages shall begin accruing.
15. Functional Test – Verification of the dynamic function and operation of equipment and systems using trending methods. Functional tests are the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional test is verifying that which has already been set up. Functional tests are performed after prefunctional checklists and startup are complete.
16. General Contractor (GC) - the prime contractor for this project. Generally refers to all the GC's subcontractors as well. Also referred to as the Contractor, in some contexts.
17. Indirect Indicators - indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed.
18. Manual Test - using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
19. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.
20. Non-Compliance - see Deficiency.
21. Over-written Value - writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50F to 75F to verify economizer operation). See also "Simulated Signal."
22. Owner-Contracted Tests - tests paid for by the Owner outside the GC's contract and for which the CA does not oversee. These tests will not be repeated during functional tests if properly documented.
23. Phased Commissioning - commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order minimize the total construction time.
24. Prefunctional Checklist (PC) - a list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CA to the Sub. Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some prefunctional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). The word prefunctional refers to before functional test. Prefunctional checklists augment and are combined with the manufacturer's start-up checklist. Even without a

commissioning process, contractors typically perform some, if not many, of the prefunctional checklist items a commissioning agent will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The commissioning agent only requires that the procedures be documented in writing, and does not witness much of the prefunctional checklisting, except for larger or more critical pieces of equipment.

25. Sampling. - Functionally testing only a fraction of the total number of identical or near identical pieces of equipment. Refer to Section 01 91 13. 1.12.D.6 for details.
26. Seasonal Performance Tests - FPV that are deferred until the system(s) will experience conditions closer to their design conditions.
27. Simulated Condition - condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).
28. Simulated Signal - disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.
29. Specifications - the construction specifications of the Contract Documents.
30. Startup - the initial starting or activating of dynamic equipment, including executing prefunctional checklists.
31. Subs - the subcontractors to the GC who provide and install building components and systems.
32. Test Procedures - the step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CA.
33. Test Requirements - requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures.
34. Trending - monitoring using the building control system.
35. Vendor - supplier of equipment.
36. Warranty Period - warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.2 COORDINATION:

A. Commissioning Team - The members of the commissioning team consist of the Commissioning Agent (CA), the owner's Construction Management firm (CM), the General Contractor (GC or Contractor), the architect and design engineers (particularly the mechanical engineer), the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB representative, the Controls Contractor (CC), subcontractors (SUBS) working on equipment being commissioned, the Owner's building engineer, and the owners representative for construction.

B. Management - The CA directs and coordinates the commissioning activities and the reports to the Owners Representative. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.

C. Scheduling - The CA will work with the CM and GC according to established protocols to schedule the commissioning activities. The CA will provide sufficient notice to the CM and GC for scheduling commissioning activities. The GC shall integrate all commissioning activities into the master schedule. All parties shall address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

D. The CA shall provide the initial schedule of primary commissioning events at the commissioning scoping meeting. As construction progresses more detailed schedules will be developed by the CA.

1.3 COMMISSIONING PROCESS

A. Commissioning Plan. The commissioning plan provides guidance in the execution of the commissioning process. Just after the initial commissioning scoping meeting the CA will update the plan which is then considered the “final” plan, though it will continue to evolve and expand as the project progresses. In the event of conflict between specifications and the commissioning the Specifications will take precedence over the Commissioning Plan.

B. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
   1. Commissioning during construction begins with a scoping meeting conducted by the CA where the commissioning process is reviewed with the commissioning team members.
   2. Additional meetings will be required throughout construction, scheduled by the CA with necessary parties attending, to plan, scope, coordinate, and schedule future activities and resolve problems.
   3. Equipment documentation is submitted to the CA during normal submittals, including detailed start-up procedures.
   4. The CA works with the Contractor and Subs in developing startup plans and startup documentation formats, including providing the Subs with prefunctional checklists to be completed, during the startup process.
   5. The checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with prefunctional checklists being completed before functional test.
   6. The Subs, under their own direction, execute and document the prefunctional checklists and perform startup and initial checkout. The CA documents that the checklists and startup were completed according to the approved plans. This may include the CA witnessing start-up of selected equipment.
   7. The CA develops specific trending procedures. The Subs review the procedures.
   8. The Functional Test procedures shall be implemented by the CA, with assistance from the Subs.
   9. Items of non-compliance in material, installation or setup are corrected at the Sub’s expense and the system retested.
   10. Commissioning is completed before Substantial Completion.
   11. Deferred testing is conducted, as specified or required.

1.4 RELATED WORK

A. Submittals Required of Contractor for Commissioning: As a minimum the Commissioning Agent shall receive a copy of the normal submittals for equipment to be commissioned.
   1. The Commissioning Agent will review and process normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with Architect review.
   2. Data for Commissioning: Provide submittal information relevant for the Products defined in the following Sections:

      22 30 00 - Plumbing Equipment

      23 05 13 - Common Motor Requirements for HVAC Equipment

      23 05 49 - Vibration and Seismic Controls for HVAC Piping and Equipment

      23 05 53 - Identification for HVAC Piping and Equipment

      23 05 93 - Testing, Adjusting, and Balancing for HVAC

      23 07 13 - Duct Insulation

      23 07 19 - HVAC Piping Insulation

      23 23 00 - Refrigerant Piping

      23 31 00 - HVAC Ducts and Casings

      23 33 00 - Air Duct Accessories

23 40 00 - HVAC Air Cleaning Devices

23 72 13 - Packaged Air-to-Air Energy Recovery Units

23 81 29 - Variable Refrigerant Volume (HRV) HVAC System

3. Contractor's responsibility for deviations in submittals from requirements of the Contractor Documents is not relieved by the Commissioning Agents review.
4. Commissioning Record and Testing Data. There will be a separate manual provided by the Commissioning Agent and the dedicated to documenting the commissioning process. This manual will include all certifications and testing data and some repetition of O&M data as described in this Section. Submission of The Commissioning Record and Test Data is not the responsibility of the contractor at the time of the project close-out.

B. Prerequisites for Substantial Completion: In addition to other requirements of Section 01 91 13, Commissioning shall be complete, except for functional testing and controls training, prior to Substantial Completion, unless approved in writing by the Owners Project Manager.

C. Contractor shall fulfill the commissioning requirements specified herein, and other sections as required by reference.

1.5 RESPONSIBILITIES

A. The responsibilities of various parties in the commissioning process are defined in this section. The responsibilities of the mechanical contractor, and controls contractor are in Division 23 and those of the electrical contractor in Division 26. The responsibilities for the owner's Construction Manager, Architect, HVAC mechanical and electrical designers/engineers are noted here for information purposes. The Contractor is not responsible for providing their services. Their responsibilities are listed here to clarify the commissioning process.

B. All Parties
1. Follow the Commissioning Plan.
2. Attend commissioning scoping meeting and additional meetings, as necessary.

C. Architect (of A/E)
Attend the commissioning scoping meeting and selected commissioning team meetings.
1. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted.
2. Provide any design narrative documentation requested by the CA.
3. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
4. Prepare and submit final as-built design intent documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
5. Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning.

D. Mechanical and Electrical Designers/Engineers (of the A/E)
1. Perform normal submittal review, construction observation, as-built drawing preparation, etc., as contracted. One site observation should be completed just prior to system startup.
2. Provide any design narrative and sequences documentation requested by the CA. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
3. Attend commissioning scoping meetings and other selected commissioning team meetings.

4. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.
5. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during commissioning during warranty-period commissioning.

E. Commissioning Agent (CA)

The primary role of the CA is to develop and coordinate the execution of a testing plan, observe and document performance that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The CA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CA may assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E. The Contractors shall provide all tools or the use of tools to start, check-out and functionally test equipment and systems, except for specified testing with portable data-loggers, which shall be supplied and installed by the CA.

1. Construction Phase
   a. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
   b. Coordinate the commissioning work and, with the GC and CM, ensure that commissioning activities are being scheduled into the master schedule.
   c. Plan and conduct a commissioning scoping meeting.
   d. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures.
   e. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
   f. Review normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews.
   g. Write and distribute prefunctional tests and checklists.
   h. Develop an enhanced start-up and initial systems checkout plan with Subs.
   i. Perform site visits, as necessary, to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies
   j. Approve prefunctional tests and checklist completion by reviewing prefunctional checklist reports and by selected site observation and spot checking.
   k. Approve systems startup by reviewing start-up reports and by selected site observation.
   l. Review TAB execution plan.
   m. Conduct and/or oversee as specified, sufficient functional test of the control system and approve it to be used for TAB, before TAB is executed.
   n. With necessary assistance and review from installing contractors, write the functional trending procedures for equipment being commissioned. This may include energy management control system trending, or stand-alone datalogger monitoring. Submit to CM for review, and for approval if required.
   o. Conduct and/or analyze, as specified, any functional test trend logs and monitoring data to verify performance.
   p. Maintain a master deficiency and resolution log and a separate testing record. Provide the CM with written progress reports and test results with recommended actions.
   q. Compile and maintain commissioning record and building systems book(s).
   r. Provide a final commissioning report.
2. Post Occupancy Phase
   a. Coordinate. Conduct, and/or supervise, as specified, required seasonal or deferred testing and deficiency corrections.

F. Construction Manager—Owner's Representative (CM)
   1 Construction Phase
      a. Facilitate the coordination of the commissioning work by the CA, and, with the GC and CA, ensure that commissioning activities are being scheduled into the master schedule.
      b. Review and approve the final Commissioning Plan.
      c. Attend a commissioning scoping meeting and other commissioning team meetings.
      d. Perform the normal review of Contractor submittals.
      e. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CA.
      f. Review and approve the functional test procedures submitted by the CA, prior to testing.
      g. Review commissioning progress and deficiency reports.
      h. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.
      i. Sign-off (final approval) on individual commissioning tests as completed and passing. Recommend completion of the commissioning process to the Project Manager.

G. General Contractor (GC)
   1 Construction Phase
      a. Facilitate the coordination of the commissioning work by the CA, with Mechanical Contractor, Sub Contractors, TAB, and Vendors. Ensure that commissioning activities are being scheduled into the master schedule.
      b. Include the cost of the general contractor and subcontractor's commissioning activities in the contract price. Note that owner will separately contract for commissioning agent and TAB services.
      c. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CA.
      d. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks and training.
      e. Shall be held responsible to make sure all Subs and vendors execute their commissioning responsibilities according to the Contract Documents and schedule.
      f. A representative shall attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Cx process.
   2 Warranty Period
      a. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

H. Equipment Suppliers
   1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
   2. Assist in equipment testing per agreements with Subs.
   3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone datalogging equipment that may be used by the CA.
   4. Provide information requested by CA regarding equipment sequence of operation and testing procedures.
   5. Review test procedures for equipment installed by factory representatives.

1.6 EQUIPMENT TO BE COMMISSIONED

A. Products defined in the following Sections shall be Commissioned:

   22 30 00 - Plumbing Equipment

   23 05 13 - Common Motor Requirements for HVAC Equipment

23 05 49 - Vibration and Seismic Controls for HVAC Piping and Equipment

23 05 53 - Identification for HVAC Piping and Equipment

23 05 93 - Testing, Adjusting, and Balancing for HVAC

23 07 13 - Duct Insulation

23 07 19 - HVAC Piping Insulation

23 23 00 - Refrigerant Piping

23 31 00 - HVAC Ducts and Casings

23 33 00 - Air Duct Accessories

23 40 00 - HVAC Air Cleaning Devices

23 72 13 - Packaged Air-to-Air Energy Recovery Units

23 81 29 - Variable Refrigerant Volume (HRV) HVAC System

1.7 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required functional test shall be provided by the Division contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the HVAC system and controls system in Division 23, except for equipment specific to and used by TAB in their commissioning responsibilities.

B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone datalogging equipment that may be used by the CA.

C. Datalogging equipment and software required to test equipment shall be provided by the CA, but shall not become the property of the Owner.

D. All testing equipment shall be of sufficient quality and accuracy to test and measure system performance with the tolerances specified in the *Specifications.* If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year and a resolution of + or - 0.5°F. Pressure sensors shall have an accuracy of + or - 2.0 percent of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

1.8 MEETINGS

A. Scoping Meeting. Within 90 days of commencement of construction, the CA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CA. Information gathered from this meeting will allow the CA to revise the Commissioning Plan to its "final" version, which will also be distributed to all parties.

B. Miscellaneous Meetings. Other meetings will be planned and conducted by the CA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Subs. The CA will plan these meetings and will minimize unnecessary time being spent by Subs. For large projects, these meetings may be held monthly, until the final 6 months of construction when they may be held as frequently as one per week.

1.9 REPORTING:

A. The CA will provide regular reports to the CM with increasing frequency as construction and commissioning progresses. Standard forms are provided and referenced in the Commissioning Plan.

B. The CA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.

C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

D. A final summary report (about four to six pages, not including backup documentation) by the CA will be provided to the CM focusing on evaluating commissioning process issues and identifying areas where the process could be improved. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the summary report. Prefunctional checklists, functional tests and monitoring reports will not be part of the final report, but will be stored in the Commissioning Record in the O&M manuals.

1.10 SUBMITTALS:

A. The CA will be provided submittal information for the equipment that is being commissioned. At a minimum, the submittals will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.

B. The Commissioning Agent will review and provide comment for the submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional test procedures and only secondarily to verify compliance with equipment specifications. The Commissioning Agent will notify the CM and contractor of items missing or areas that are not in conformance with Contract Documents and which require resubmission.

C. The CA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.

D. These submittals to the CA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CA will review and approve them.

1.11 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT:

A. The following procedures apply to Products listed in 1.6.

B. General. Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional test (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling shall be used. The prefunctional test for a given system must be successfully completed prior to formal functional test of equipment or subsystems of the given system. In the event of equipment or a system failure to startup and operate for a functional

test, it shall be deemed to be a deficiency subject to retesting at the Contractors cost. In the event that formal functional test of any equipment, system, or subsystem can not be performed due to start-up or operational failure for any reason, the Contractor shall be responsible for any and all costs of retesting including all direct, indirect and incidental including travel costs of other Commissioning Team members.

C. Start-up and Initial Checkout Plan. The CA shall assist the commissioning team members responsible for startup of any equipment in developing detailed start-up plans for all equipment. The primary role of the CA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. Parties responsible for prefunctional checklists and startup are identified in the commissioning scoping meeting and in the checklist forms.

D. Execution of Prefunctional Checklists and Startup.
   1. Four weeks prior to equipment or system startup, the Subs shall schedule the startup and prefunctional tests with the CM, GC and CA. The prefunctional checklists, startup and checkout shall be directed and executed by the Sub.
   2. The CA shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, (in which case a sampling strategy may be used as approved by the CM). In no case will the number of units witnessed be less than four on any one building, nor less than 20 percent of the total number of identical or very similar units.
   3. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CA shall observe a sampling of the prefunctional and start-up procedures. The sampling procedures are identified in the commissioning plan.
   4. The Subs and vendors shall execute startup and provide the CA with a signed and dated copy of the completed start-up and prefunctional tests and checklists.
   5. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

E. Deficiencies, Non-Conformance and Approval in Checklists and Startup.
   1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CA within two days of test completion.
   2. The CA shall review the report and submit either a non-compliance report or an approval form to the Sub or CM. The CA shall work with the Subs and vendors to correct and retest deficiencies or uncompleted items. The CA will involve the CM and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CA shall recommend approval of the execution of the checklists and startup of each system to the CM using a standard form.
   3. Items left incomplete, which later cause deficiencies or delays during functional test may result in backcharges to the responsible party.

1.6 FUNCTIONAL TEST

A. This sub-section applies to all commissioning functional test for all divisions.

B. The general list of equipment to be commissioned is found in Section 01 91 13 1.6.

C. Objectives and Scope. The objective of functional test is to demonstrate, through trending, that each system is operating according to the documented design intent and Contract

Documents. Functional test facilitates bringing the systems from a state of substantial completion to full dynamic operation.

D. Testing Methods

1. Verification shall occur by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers. The methods to be used for each system to be commissioned are specified in the specific specification sections. The CA shall determine which method is most appropriate for tests that do not have a method specified.
2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
3. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
4. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55F, when the outside air temperature is above 55F, temporarily change the lockout setpoint to be 2F above the current outside air temperature.
5. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses.
6. Sampling.
   a. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. The specific recommended sampling rates are specified with each type of equipment in specific system specifications sections. It is noted that no sampling by Subs is allowed in prefunctional checklist execution.
   b. A common sampling strategy referenced in the *Specifications* as the "xx percent Sampling—yy percent Failure Rule" is defined by the following example.
      xx = the percent of the group of identical equipment to be included in each sample.
      yy = the percent of the sample that if failing, will require another sample to be tested.

      The example below describes a 20 percent Sampling—10 percent Failure Rule.
      1. Randomly test at least 20 percent (xx) of each group of identical equipment. In no case test less than three units in each group. This 20 percent, or three, constitute the "first sample."
      2. If 10 percent (yy) of the units in the first sample fail the functional test, test another 20 percent of the group (the second sample).
      3. If 10 percent of the units in the second sample fail, test all remaining units in the whole group.
      4. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CA may stop the testing and require the

responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

E. Coordination and Scheduling.

The Subs shall provide sufficient notice to the CA regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The CA will schedule functional tests through the CM, GC and affected Subs. The CA shall direct, witness and document the functional test of all equipment and systems. The Subs shall execute the tests, as specified. In some cases, the CA shall execute the tests with the direct assistance of subs.

1. The control system is sufficiently tested and approved by the CA before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before trending of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

F. Test Equipment. Refer to paragraph 1.7 for test equipment requirements.

G. Problem Solving. The CA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.

1.13 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF VERIFICATION:

A. Documentation. The CA shall document the results of all functional test using the specific procedural forms developed for that purpose. The CA will include the filled out forms in the O&M manuals.

B. Non-Conformance.

1. The CA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the CM on a standard non-compliance form.
2. Deficiencies and resolutions will be documented on the procedure form.
3. As tests progress and a deficiency is identified, the CA shall discuss the issue with the executing contractor.
    a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
        1) The CA shall document documents the deficiency and the Sub's response and intentions, and shall then progress on to another test or sequence. Within one day, the CA shall submit the non-compliance reports to the CM for signature, if required. A copy shall be provided to the Sub and CA. The Sub shall correct the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and send the non-compliance form back to the CA.
        2) The CA shall reschedule the trend and the trends shall be repeated.
    b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
        1) The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the CM and to the Sub representative assumed to be responsible.
        2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the CM.
        3) The CA documents the resolution process.
        4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-

compliance form and provides it to the CA. The CA reschedules the test and the test is repeated until satisfactory performance is achieved.

4. Cost of Retesting.
   The cost to retest a prefunctional or functional test due to equipment or system failure shall be for the GC's account.
   a. Costs of retesting include all direct and indirect, incidental and travel costs of commissioning team members and equipment as needed.
   b. Refer to sampling section for requirements for testing and retesting identical equipment.
5. The Contractor shall respond in writing to the CA and CM at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
6. The CA retains the original non-conformance forms until the end of the project.

C. Failure Due to Manufacturer Defect. If 10 percent, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the CM or PM. In such case, the Contractor shall provide the Owner with the following:
   a. Within one week of notification from the CM or PM, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the CM or PM within two weeks of the original notice.
   b. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
   c. The CM or PM will determine whether a replacement of all identical units or a repair is acceptable.
   d. Two examples of the proposed solution will be installed by the Contractor and the CM will be allowed to test the installations for up to one week, upon which the CM or PM will decide whether to accept the solution.
   e. Upon acceptance, the Contractor or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

D. Approval. The CA shall note each satisfactorily demonstrated function on the test form. Formal approval of the functional test shall be made later after review by the CA and by the CM, if necessary. The CA shall recommend acceptance of each test to the CM using a standard form. The CM shall give final approval on each test using the same form, providing a signed copy to the CA and the Contractor.

1.14 OPERATION AND MAINTENANCE MANUALS:

A. Standard O&M Manuals.
   1. The specific content and format requirements for the standard O&M manuals are detailed in Section 01 91 13.

   2. CA Review and Approval. Prior to substantial completion, the CA shall review the O&M manuals, documentation and redline as-builds for systems that were commissioned to verify compliance with the Specifications. The CA will communicate deficiencies in the manuals to the CM, PM or A/E, as requested. Upon a successful review of the corrections, the CA recommends approval and acceptance of these sections of the O&M manuals to the CM or A/E. The CA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

B. Commissioning Record in O&M Manuals.

1. The CA is responsible to compile, organize and index the following commissioning data by equipment into labeled, indexed and tabbed, three-ring binders and deliver it to the GC, to be included with the O&M manuals. Three copies of the manuals will be provided. The format of the manuals shall be:

Tab I-1 Commissioning Plan
Tab I-2 Final Commissioning Report
Tab 01 System Type 1 (HVAC Controls)
Sub-Tab A Design narrative and criteria, sequences, approvals for Equipment 1
Sub-Tab B Startup plan and report, approvals, corrections, blank prefunctional checklists
Colored Separator Sheets—for each equipment type (fans, pumps, chiller, etc.)
Sub-Tab C Functional tests (completed), trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms and a recommended recommissioning schedule.
Tab 02 System Type 2 (Lighting Control System)

3. Other documentation shall be retained by the CA.

1.15 DEFERRED TESTING:

A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional test may be delayed upon approval of the PM. These tests shall be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties shall be negotiated.

B. Seasonal Verification. During the warranty period, seasonal verifications (trending delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CA shall coordinate this activity. Any final adjustments to the O&M manuals and as-builds due to the testing shall be made.

1.16 WRITTEN WORK PRODUCTS:

A. The commissioning process generates a number of written work products described in various parts of the Specifications. In summary, the written products are:

Product	Developed By
1. Final commissioning plan	CA
2. Meeting minutes	CA
3. Commissioning schedules	CA with GC and CM
4. Equipment documentation submittals	Subs
5. Sequence clarifications	Subs and A/E as needed
5. Prefunctional checklists	CA
6. Startup and initial checkout plan	Subs and CA
7. Startup and initial checkout forms filled out	Subs
8. Final TAB report	TAB
9. Issues log (deficiencies)	CA
10. Commissioning Progress Record	CA
11. Deficiency reports	CA
12. Functional test forms	CA
13. Filled out functional tests	CA
15. Commissioning record book	CA
18. Final commissioning report	CA
19. Misc. approvals	CA

END OF SECTION

SECTION 02 4100

DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition and recycling of mechanical, plumbing system, electrical and building elements for removal and replacement.

B. Partial Demolition of built-up roof.

C. Temporary removal and re-installation of exising acoustic ceiling tile for access to mechanical and electrical systems.

1.02 RELATED REQUIREMENTS

A. Section 01 0100 - Summary of Work: Limitations on Contractor's use of site and premises.

B. Section 01 0110 - Work Sequence / Coordination: Sequencing and staging requirements.

C. Section 01 0450 - Cutting and Patching.

D. Section 01 2300 - Alternates: Description of items to be removed as an alternate bid option.

E. Section 01 6000 - Material and Equipment: Handling and storage of items removed for salvage and relocation.

F. Section 01 7000 - Contract Closeout: Project conditions; protection of bench marks, and existing construction to remain; reinstallation of removed products; documentation of existing buildings.

1.03 REFERENCE STANDARDS

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

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Site Plan: Showing:
   1. Vegetation to be protected.
   2. Areas for temporary construction and field offices.
   3. Areas for temporary and permanent placement of removed materials.
   4. Areas for location of dumpsters

C. Demolition Plan: Submit demolition plan
   1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barriers, barricades and fences.
   2. Identify demolition firm and submit qualifications.
   3. Include a summary of safety procedures.

D. Photo documentation of existing acoustic ceiling tile (ACT) ceiling.
   1. Prior to beginning work, photo document the existing ACT ceiling of sufficient detail to identify previously damaged tiles.

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

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE

A. Remove portions of existing building systems and components as shown on Demolition plans :

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.

2. Provide, erect, and maintain temporary barriers and security devices.
3. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
5. Do not close or obstruct roadways or sidewalks without permit or written permission from Owner.
6. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.

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

C. Protect existing buiding sytems and other elements that are not to be removed.

D. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.

E. Perform demolition in a manner that maximizes salvage and recycling of materials.
1. Dismantle existing construction and separate materials.
2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

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

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

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without 7 days prior written notification to Owner.

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

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

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
1. Verify that construction and utility arrangements are as shown.
2. Report discrepancies to Owner and Architect before disturbing existing installation.
3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Separate areas in which demolition is being conducted from other areas that are still occupied.
1. Protect all HVAC diffusers and grills by covering with dust proof barrier.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

D. Remove existing work as indicated and as required to accomplish new work.
1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
2. Remove items indicated on drawings.
3. Temporarily remove existing acoustic ceiling tiles and supporting metal grid for removal existing HVAC system and piping. Following installation of new work, reinstall grid and acoustic ceiling tiles. Replace damaged tiles and grid.

4. Temporarily detach light fixtures and sprinklerheads as required for removal of acoustic ceiling tiles and supporting grid to accomodate above ceiling-HVAC work. Following installation of new work, reinstall light fixtures and sprinkler heads. Replace any damaged fixtures or sprinkler heads.

E. Services (Including but not limited to HVAC, Plumbing, and Electrical): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Verify that abandoned services serve only abandoned facilities before removal.
      a. Under base scope: Existing condenser piping and related components above ceiling serving removed units are to be drained and abandoned in place.
      b. Under Alternate #1: Existing condenser piping and related components above ceiling serving removed units are to be drained and removed entirely, with as little disruption to building operations as possible.
      c. Modification of air side of HVAC system is limited to accommodating new VRF system Most ductwork to remain.
   4. Where indicated for removal, remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

F. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete reinforcement.

B. Miscellaneous site concrete elements, including equipment pads and fence post footings.

C. Concrete curing.

1.02 REFERENCE STANDARDS

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).

B. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010.

C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.

D. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.

E. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.

F. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001 (Reapproved 2008).

G. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.

H. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Billet-Steel Bars for Concrete Reinforcement; 2014.

I. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.

J. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2014.

K. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2014.

L. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.

M. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2012.

N. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.

O. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2007.

P. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.

Q. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.

R. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.

S. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.

T. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2012.

U. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014.

V. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).

W. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2008).

X. ASTM E1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers [Metric]; 1996 (Reapproved 2008).

1.03 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

C. Design Mix: Submit concrete design mix.

D. Reinforcing Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

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

1.04 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

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

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

PART 2 PRODUCTS

2.01 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 40 - 40,000 psi.
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.

B. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel or galvanized components for placement within 1-1/2 inches of weathering surfaces.

C. Welded Anchor: Nelson Anchor J2L 1/2 inch by 9"

2.02 CONCRETE MATERIALS

A. Cement: ASTM C150, Type II - Moderate Portland type.
   1. Acquire all cement for entire project from same source.

B. Fine and Coarse Aggregates: ASTM C 33.
   1. Acquire all aggregates for entire project from same source.

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

D. Water: Clean and not detrimental to concrete.

2.03 ADMIXTURES

A. Chemical Admixture Manufacturers: Any that meet the requirements of this section.

B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

C. Air Entrainment Admixture: ASTM C260/C260M.

D. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.

2.04 ACCESSORY MATERIALS

A. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 28 Days: 7,000 psi.

B. Moisture-Retaining Cover: ASTM C171; regular curing paper, white curing paper, clear polyethylene, white polyethylene, or white burlap-polyethylene sheet.

2.05 BONDING AND JOINTING PRODUCTS

A. Joint Filler: Nonextruding, resilient asphalt impregnated fiberboard or felt, complying with ASTM D 1751, 1/4 inch thick and 4 inches deep; tongue and groove profile.

B. Sealant and Primer: As specified in Section 07 9005.

2.06 CURING MATERIALS

A. Moisture-Retaining Sheet: ASTM C171.
   1. Curing paper, regular.
   2. Polyethylene film, clear, minimum nominal thickness of 0.0040 in..
   3. White-burlap-polyethylene sheet, weighing not less than 10 oz/per linear yd, 40 inches wide.

B. Water: Potable, not detrimental to concrete.

2.07 CONCRETE MIX DESIGN

A. Proportioning Medium Weight Concrete: Comply with ACI 211.1 recommendations.

B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

C. Normal Weight Concrete:
   1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,000 psi.
   2. Water-Cement Ratio: Maximum 48 percent by weight.
   3. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
   4. Maximum Slump: 4 inches.
   5. Aggregate: 1 1/2 inch minus for interior slabs on grade, 3/4 inch minus for footings and foundations, exterior slabs on grade, interior slabs on grades less than 6" thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Notify Owner's Representative not less than 72 hours prior to commencement of placement operations.

3.05 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Pitch surfaces uniformly to 1/8"/ft nominal to slab edges.

3.06 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Surfaces Not in Contact with Forms:
   1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water-fog spray or saturated burlap.
      a. Spraying: Spray water over floor slab areas and maintain wet.
      b. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
   2. Final Curing: Begin after initial curing but before surface is dry.
      a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
      b. Moisture-Retaining Cover: Seal in place with waterproof tape or adhesive.

3.07 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.08 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

3.09 SCHEDULE - CONCRETE TYPES AND FINISHES

A. Site Concrete: 4,000 psi 28 day concrete design strength with light broom finish

END OF SECTION

SECTION 05 5000

METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bollards

B. Slotted channel framing

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.

B. Section 09 9000 - Painting and Coating: Shop Prime products for bollards

C. Section 26 22 00 - Transformers: To be supported by slotted channel framing

1.03 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

B. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Pipe: ASTM A53/A53M, Grade B Schedule 40, hot-dip galvanized finish.

B. Slotted Channel Framing: ASTM A653/A653M, Grade 33.

C. Slotted Channel Fittings: ASTM A1011/A1011M.

D. Galvanized Touch-Up Primer: ZRC Cold Galvanizing Compound, ZRC Worldwide or approved equal. Conforming to Federal Specification DOD-P-213035A repair of hot dip galvanizing., complying with VOC limitations of authorities having jurisdiction.

E. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by intermittent welds and plastic filler.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; Prime paint finish. Prime paint per Section 09 9000.

B. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.
   1. Manufacturer: Unistrut
   2. Manufacturer: Hilti
   3. Substitutions: See Section 01 6000 - Material and Equipment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

D. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 07 0150.19

PREPARATION FOR RE-ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removal of existing roofing system in preparation for a new roof membrane system.

1.02 REFERENCE STANDARDS

A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2012.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with affected mechanical and electrical work associated with roof penetrations.

B. Preinstallation Meeting: Convene one week before starting work of this section.

C. Schedule work to coincide with commencement of installation of new roofing system.

1.04 FIELD CONDITIONS

A. Do not remove existing roofing membrane when weather conditions threaten the integrity of the building contents or intended continued occupancy.

B. Maintain continuous temporary protection prior to and during installation of new roofing system.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that existing roof surface is clear and ready for work of this section.

2.02 PREPARATION

A. Sweep roof surface clean of loose matter.

B. Remove loose refuse and dispose off site.

2.03 MATERIAL REMOVAL

A. Remove only existing roofing materials that can be replaced with new materials the same day.

B. Remove metal counter flashings.

C. Remove damaged portions of roofing membrane, perimeter base flashings, flashings around roof protrusions, pitch pans and pockets.

D. Remove damaged insulation and fasteners, cant strips, and blocking.

E. Remove vapor retarder.

2.04 PROTECTION

A. Install recovery board over existing membrane.

END OF SECTION

SECTION 07 5200

MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Modified bituminous roofing membrane, conventional application.

B. Insulation, flat and tapered.

C. Base flashings.

D. Roofing cant strips, accessories, and roofing expansion joints.

1.02 RELATED REQUIREMENTS

A. Section 07 7200 - Roof Accessories: Prefabricated curb for mechanical equipment.

1.03 REFERENCE STANDARDS

A. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011.

B. ASTM D312 - Standard Specification for Asphalt Used in Roofing; 2000 (Reapproved 2006).

C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012)e1.

D. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of associated flashings and counterflashings installed by other sections.

B. Coordinate with removal of existing roof curbs, HVAC equipment and installation of new roof curbs and new HVAC equipment.

C. Preinstallation Meeting: Convene one week before starting work of this section.

1. Review preparation and installation procedures as well as coordination and scheduling required with regard to related work installed by other disciplines.

1.05 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide manufacturer's catalog data for membrane and bitumen materials, base flashing materials, insulation, vapor retarder, and surfacing.

C. Manufacturer's Installation Instructions: Indicate special procedures.

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

1.06 QUALITY ASSURANCE

A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.

B. Manufacturer Qualifications: The manufacturer shall be the same manufacturer as for the existing/original roof.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience, and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

B. Store products in weather protected environment, clear of ground and moisture; ballast materials may be stored outdoors.

1.08 FIELD CONDITIONS

A. Do not apply roofing membrane when environmental conditions are outside the ranges recommended by manufacturer.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is below 40 degrees F.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

1.09 WARRANTY

A. See Section 01 7000 - Contract Closeout, for additional warranty requirements.

B. Correct defective Work within a two year period after Date of Substantial Completion.

C. Maintain original roof warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Membrane Materials: Match adjacent existing roof membrane materials
   1. Substitutions: See Section 01 6000 - Material and Equipment.

B. Insulation: Polyisocyanurate insulation
   1. Substitutions: See Section 01 6000 - Material and Equipment.

2.02 ROOFING - CONVENTIONAL APPLICATION

A. Modified Bituminous Roofing: 4 ply system with mineral cap sheet, with vapor retarder and insulation. Provide high density re-cover board over insulation.

B. Roofing Assembly Requirements:
   1. External Fire Exposure Classification: ASTM E108 Class A, UL listed.
   2. Insulation Thermal Value (R), minimum: Match existing thickness or 3 inches minimum; provide insulation of thickness required.

C. Acceptable Insulation Types - Tapered Application: Any of the types specified.
   1. Tapered polyisocyanurate, perlite, or extruded polystyrene board.

2.03 BITUMINOUS MATERIALS

A. Bitumen: Asphalt, ASTM D312 Type IV; for adhering insulation, use Type III.

B. Primer: ASTM D41/D41M, asphalt type.

C. Roof Cement: ASTM D4586/D4586M, Type II.

2.04 ACCESSORIES

A. Roofing Expansion Joint Flashing: Sheet butyl.

B. Cant and Edge Strips: Asphalt-impregnated wood fiberboard, compatible with roofing materials; cants formed to 45 degree angle.

C. Pipe Flashing: Provide pre-molded pipe flashings for electrical conduits

D. Sealants: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 CONCRETE DECK PREPARATION

A. Fill surface honeycomb and variations with latex filler.

B. Confirm dry deck by moisture meter with 12 percent moisture maximum.

3.03 INSULATION INSTALLATION - CONVENTIONAL APPLICATION

A. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

B. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

C. Do not apply more insulation than can be covered with membrane in same day.

3.04 MEMBRANE APPLICATION

A. Apply membrane in accordance with manufacturer's instructions.

B. Apply membrane; lap and seal edges and ends permanently waterproof.

C. Apply smooth, free from air pockets, wrinkles, fish-mouths, or tears. Ensure full bond of membrane to substrate.

D. At end of day's operation, install waterproof cut-off. Remove cut-off before resuming roofing.

E. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 8 inches onto vertical surfaces.
   2. Apply flexible flashing over membrane.

F. Around roof penetrations, mop in and seal flanges and flashings with flexible flashing.

G. Coordinate installation of roof drains and sumps and related flashings.

3.05 CLEANING

A. Remove bituminous markings from finished surfaces.

B. In areas where finished surfaces are soiled by bitumen or other source of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.06 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, and Sheet Metal Shroud.

B. Reglets and accessories.

1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.

B. ASTM B32 - Standard Specification for Solder Metal; 2008.

C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012)e1.

D. SMACNA 1793 - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012.

1.03 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA 1793 and CDA CA4050 requirements and standard details, except as otherwise indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch thick base metal.

2.02 ACCESSORIES

A. Fasteners: Stainless steel, with soft neoprene washers.

B. Primer: Zinc chromate type.

C. Plastic Cement: ASTM D4586, Type I.

D. Reglets: Surface mounted type, galvanized steel; face and ends covered with plastic tape; SM manufactured by Fry.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 INSTALLATION

A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted. And with surface mounted reglets

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

3.03 SCHEDULE

A. Refrigerant Piping Shroud:
   1. Material: Galvanized Metal.
   2. Thickness: 22 Gage

END OF SECTION

SECTION 07 7100
ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flashing for roof penetrations in metal roof.

1.02 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Pipe and Penetration Flashings
   1. Dektite EPDM Roof Flashing with 20 year warranty.
   2. Model: As required to fit pipe and installation
   3. Substitutions: See Section 01 6000 - Material and Equipment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions.

END OF SECTION

SECTION 07 9005

JOINT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sealants and joint backing.

B. Precompressed foam sealers.

1.02 RELATED REQUIREMENTS

A. Section 07 62 00 - Sheet Metal Flashing and Trim: Sealants required in conjunction with sheet metal

1.03 REFERENCE STANDARDS

A. ASTM C834 - Standard Specification for Latex Sealants; 2010.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.

D. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2014.

E. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for concrete Pavements; 1991 (Reapproved 2011).

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide data indicating sealant chemical characteristics.

1.05 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.06 COORDINATION

A. Coordinate the work with all sections referencing this section.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sealants:
   1. Bostik, Inc
   2. Pecora Corporation
   3. GE Plastics
   4. BASF Construction Chemicals
   5. Dow Corning.
   6. Substitutions: See Section 01 6000 - Material and Equipment.

2.02 SEALANTS

A. Type A - Silicone Building Sealant: Type S; ASTM C 920, Grade NS, Class 100/50, Uses T,NT M, G, A and O; single component.
   1. Color: Standard and Custom colors matching adjacent surfaces.
   2. Product: 790 manufactured by Dow Corning.
   3. Applications: Use for:
      a. Control, expansion, and soft joints in masonry.
      b. Joints between concrete and other materials.
      c. Joints between metal frames and other materials.
      d. General Building Sealant.
      e. Other exterior joints for which no other sealant is indicated.

B. Type C - Exterior Metal Lap Joint Sealant: Butyl Sealant nondrying, nonskinning, noncuring.

1. Product: BC-158 manufactured by Pecora.
2. Applications: Use for:
    a. Concealed sealant bead in sheet metal work.
    b. Concealed sealant bead in siding overlaps.

C. Type D - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C 834, Type OP, Grade NF single component, paintable.
1. Color: Standard colors matching finished surfaces.
2. Product: AC-20 manufactured by Pecora.
3. Applications: Use for:
    a. Interior wall and ceiling control joints.
    b. Interior joints between door and window frames and wall surfaces.
    c. Other interior joints for which no other type of sealant is indicated.

2.03 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

E. Butyl Tape: Manufacturer: GSSI Sealants: Product: EZ Trime

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean and prime joints in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

D. Install bond breaker where joint backing is not used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

G. Tool joints concave.

H. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

I. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

3.04 CLEANING

A. Clean adjacent soiled surfaces.

3.05 PROTECTION

A. Protect sealants until cured.

3.06 SCHEDULE

A. As specified in this and other sections seal as follows:
   1. Exterior joints between disimilar materials
   2. Lap Joints in exterior sheet metal work
   3. Under door thresholds

B. Joints Between Exterior Metal Frames and Adjacent Work

C. Under Exterior Door Thresholds:

END OF SECTION

SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal channel ceiling framing.

B. Joint treatment and accessories.

C. Ceiling board for suspended ceilings.

1.02 RELATED REQUIREMENTS

A. Section 09 9000 - Painting and Coating:

1.03 REFERENCE STANDARDS

A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2012.

B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2013.

C. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.

D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.

E. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2011.

F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2007 (Reapproved 2013).

G. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2010a.

H. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2013.

I. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.

J. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.

K. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

C. Samples: Submit two samples of gypsum board finished with proposed texture application, 12 by 12 inches in size, illustrating finish color and texture.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum five years of documented experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

2.02 METAL FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
   1. Runners: U shaped, sized to match studs.
   2. Ceiling Channels: C shaped.

B. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

C. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short .

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. American Gypsum: www.americangypsum.com.
   2. Georgia-Pacific Gypsum: www.gpgypsum.com.
   3. National Gypsum Company: www.nationalgypsum.com.
   4. USG Corporation: www.usg.com.
   5. Substitutions: See Section 01 6000 - Material and Equipment.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Thickness:
      a. Vertical Surfaces: 1/2 inch.

C. Backing Board For Wet Areas: One of the following products:
   1. Application: New shower ceiling.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
      a. Fire-Resistant Type: Type X core, thickness 5/8 inch.
      b. Products:
         1) Georgia-Pacific Gypsum; DensShield Tile Backer.
         2) Substitutions: See Section 01 6000 - Material and Equipment.

2.04 ACCESSORIES

A. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless otherwise indicated.
   1. Types: As detailed or required for finished appearance.
   2. Special Shapes: In addition to conventional cornerbead and control joints, provide U-bead at exposed panel edges.

B. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
   1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.

C. Screws for Attachment to Steel Members Less Than 0.03 inch In Thickness, to Wood Members, and to Gypsum Board: ASTM C1002; self-piercing tapping type; cadmium-plated for exterior locations.

D. Screws for Attachment to Steel Members From 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws for application of gypsum board to loadbearing steel studs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Level ceiling system to a tolerance of 1/1200.
   2. Laterally brace entire suspension system.

3.03 BOARD INSTALLATION

A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as directed.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.05 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

3.06 FINISH

A. Gypsum Board Finish Levels: Finish panels according to manufacturer's written instructions to levels indicated below and according to ASTM C 840:
   1. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
      a. Primer and its application to surfaces are specified in other Division 9 Sections.

3.07 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system and perimeter trim to replace system damaged through removal and re-installation.

B. Acoustical units to replace tile units damaged through removal and re-installation.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Walls terminating at and through ceilings

1.03 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 2013.

C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.

D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2008e1.

E. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

F. Ceilings and Interior Systems Contractors Association (CISCA) Acoustical Ceilings: Use and Practice.

1.04 SYSTEM DESCRIPTION

A. Suspension system to rigidly secure acoustical ceiling system including integral mechanical and electrical components with maximum deflection of 1/360.

B. Comply with all applicable Uniform Building Code requirements for seismic bracing of suspended acoustical ceiling system.

1.05 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide data on suspension system components, acoustical units, and system accessories.

C. Samples: Submit two samples 12 x 12 inch in size illustrating material and finish of acoustical units.

D. Samples: Submit two samples each, 12 inches long, of suspension system main runner.

E. Manufacturer's Installation Instructions: Indicate special procedures.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable Uniform Building Code regulations for fire rated assembly and combustibility requirements for materials.

B. Comply with all applicable Uniform Building Code requirements for seismic bracing of suspended acoustical ceiling system.

1.07 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.08 PROJECT CONDITIONS

A. Convene a pre-installation meeting one week prior to starting work in this section.

B. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

C. Install acoustical units after interior wet work is dry.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

A. Manufacturers:
   1. Armstrong; Product 769A (Basis of Design - Actual must match existing)

B. Acoustical Units - General: ASTM E1264, Class A.

C. Acoustical Replacement Panels at all indicated locations: ASTM E1264; Flame Spread 25 or under, conforming to the following:
   1. Size: 24 x 48 inches (300 x 300 mm).
   2. Thickness: 5/8 inches.
   3. Composition: mineral.
   4. Density: 1 lb/cu ft.
   5. Light Reflectance:.82 percent, determined in accordance with ASTM E1264.
   6. NRC Range: 0.50 to .60 determined as specified in ASTM E 1264.
   7. Edge: Square.
   8. Surface Color: White.
   9. Surface Pattern: Non-directional fissured.

2.02 SUSPENSION SYSTEM(S)

A. Manufacturers:
   1. Donn; Product: DX (As basis of bid - Actual system must match existing)
   2. Substitutions: See Section 01 6000 - Material and Equipment.

B. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

C. Exposed Steel Suspension System: Formed galvanized steel, commercial quality cold rolled; intermediate-duty.
   1. Profile: Tee; 15/16 inch wide face.
   2. Construction: Double web.
   3. Finish: White painted.

2.03 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Perimeter Moldings: Same material and finish as grid.
   1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C 636, ASTM E 580, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

F. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

J. Do not eccentrically load system or induce rotation of runners.

K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Miter corners.

L. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

3.03 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Lay directional patterned units with pattern parallel to longest room axis.

D. Fit border trim neatly against abutting surfaces.

E. Install units after above-ceiling work is complete.

F. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

G. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.

H. Where round obstructions occur, provide preformed closures to match perimeter molding.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 9000

PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exterior Sheet Galanized Metal
   2. Interior Gypsum Board

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Shop-primed items.

1.03 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2012.

B. SSPC (PM1) - Good Painting Practice: SSPC Painting Manual, Vol. 1; Society for Protective Coatings; Fourth Edition.

1.05 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified. Provide up to 3 rounds of sample colors for selection purposes.
   1. Allow 30 days for approval process, after receipt of complete samples by Architect.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and coated surfaces, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Material and Equipment, for additional provisions.
   2. Extra Paint and Coatings: 1 gallon of each color; store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.

B. Paints:
1. Base Manufacturer: Benjamin Moore.
2. Duron, Inc: www.duron.com.
3. Glidden Professional, a product of PPG Architectural Coatings: www.gliddenprofessional.com.
4. Benjamin Moore & Co: www.benjaminmoore.com.
5. Sherwin-Williams Company: www.sherwin-williams.com.
6. Miller Paint: www.millerpaint.com.

C. Substitutions: See Section 01 6000 - Material and Equipment.

2.02 PAINTS AND COATINGS - GENERAL

A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Supply each coating material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Colors: As indicated on drawings
1. Selection to be made by Architect after award of contract.
2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint ferrous and shop pre-primed and galvanized steel.
1. Primer: High Performance, rust inhibiting one component etching primer.
   a. Base Product: CORONADO Coro-bond Super Etch Primer
2. Aliphatic Acrylic Urethane (2 coats)
   a. Base Product: M74/M75Aliphatic Acrylic Urethane

2.04 PAINT SYSTEMS - INTERIOR

A. Paint I-OP-HD - Heavy Duty Vertical and Overhead: Including gypsum board, plaster, concrete, concrete masonry, uncoated steel, shop primed steel, galvanized steel, and aluminum.
1. Applications: New gypsum board ceiling.

2. Two top coats and one coat primer; primer may be omitted if top coat manufacturer approves.
3. Primer(s): As recommended by manufacturer of top coats.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Test shop-applied primer for compatibility with subsequent cover materials. Test shall include be performed by paint manufacturer's representative.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Gypsum Wallboard: 12 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to coating application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Degrease all metal using a solvent or commercial degreaser.

C. Remove or repair existing coatings that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.

H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

I. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-SP 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).

J. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

K. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Apply paint system to all components of the metal building system prior to installation of PV panels.

C. Apply paint system to conduits following installation of PV system

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance.

F. Sand wood and metal surfaces lightly between coats to achieve required finish.

G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.

B. Test each coat for thickness prior to installing next coat. Test shall be performed by paint manufacturer representatives. Results submitted to architect for approval prior to next coat being installed

C. Adhesion Test. Test each coat for adhesion according to ASTM D3359. Submit results to architect prior to application of next coat being installed. Test shall be performed by paint manufacturer.

END OF SECTION

SECTION 22 0548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Seismic restraints.

1.02 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2011.

B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2011.

C. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2002.

D. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage: A Practical Guide; 2011.

E. SMACNA 1981 - Seismic Duct Restraint Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2008.

1.03 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data:
   1. Provide manufacturer's product literature documenting compliance with PART 2 PRODUCTS.
   2. Include seismic rating documentation for each isolator and restraint component accounting for horizontal, vertical, and combined loads.

C. Shop Drawings:
   1. Fully dimensioned fabrication drawings and installation details for member sizes, attachments to structure, and supported equipment.
   2. Clearly indicate the load and capacity assumptions selected. Include copies of any calculations.
   3. Include the calculations that indicate compliance with the applicable building code for seismic controls and the vibration isolator manufacturer's requirements.
   4. Include the seal of the Professional Engineer registered in the State of Oregon in which the Project is located, on the drawings and calculations which at a minimum include the following:
      a. Seismic Restraint Details: Detailed drawings of seismic restraints and snubbers including anchorage details that indicate quantity, diameter, and depth of penetration, edge distance, and spacing of anchors.
      b. Equipment Seismic Qualification Certification: Certification by the manufacturer or responsible party that each piece of equipment provided will withstand seismic force levels as specified in the applicable building code for seismic controls.
         1) Basis for Certification: Indicate whether the withstand certification is based on actual testing of assembled components, on calculations, or on historic data.
         2) Indicate equipment to be sufficiently durable to resist design forces and or remain functional after the seismic event.
      c. Dimensioned outline drawings of equipment identifying center of gravity, locations, and provisions for mounting and anchorage.
      d. Detailed description of the equipment anchorage devices on which the certifications are based.

D. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

1.04 QUALITY ASSURANCE

A. Perform design and installation in accordance with applicable codes.

B. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and registered and licensed in the State in which the Project is located (Oregon).

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Kinetics Noise Control, Inc: www.kineticsnoise.com.

B. Mason Industries: www.mason-ind.com.

C. Vibration Eliminator Company, Inc: www.veco-ny.com.

D. Substitutions: See Section 01 6000 - Material and Equipment.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions.

3.02 INSTALLATION - SEISMIC

A. Comply with:
   1. ASHRAE Handbook - HVAC Applications.
   2. SMACNA 1981.

B. Floor and Base-Mounted Equipment, Vibration Isolated Equipment and associated Vibration and Seismic Controls for Connections:
   1. Install equipment anchorage items designed to resist seismic design force in any direction.
   2. Install vibration and seismic controls designed to include base and isolator requirements.

END OF SECTION

SECTION 22 0553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

1.03 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Heat Transfer Equipment: Nameplates.

2.02 MANUFACTURERS

A. Brady Corporation

B. Champion America, Inc

C. Seton Identification Products

2.03 NAMEPLATES

A. Manufacturers:
   1. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   2. Seton Identification Products: www.seton.com.
   3. Substitutions: See Section 01 6000 - Material and Equipment.

B. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch.
   3. Background Color: Black.
   4. Plastic: Conform to ASTM D709.

2.04 PIPE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradycorp.com.
   2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   3. MIFAB, Inc.: www.mifab.com.
   4. Seton Identification Products: www.seton.com.
   5. Substitutions: See Section 01 6000 - Material and Equipment.

B. Comply with ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion.

B. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

C. Identify heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

D. Identify control panels and major control components outside panels with plastic nameplates.

E. Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping.

END OF SECTION

SECTION 22 0719

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

B. Section 23 2300 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

A. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2013.

C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2012.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2013.

F. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER PIPING INSULATION

A. Manufacturers:
   1. Knauf Insulation: www.knaufusa.com.
   2. Johns Manville Corporation MicroLok HP

3. Owens Corning Corp SSL II
4. CertainTeed Corporation
5. Knauf Earthwool
6. Substitutions: See Section 01 6000 - Material and Equipment.

B. Insulation: ASTM C547 ; class 3, rigid molded, noncombustible.
1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches, with self-sealing longitudinal closure laps (SSL) and butt strips. Shall comply with Oregon Revised Statute 853.085 by containing less than 0.10% decabromodiphenyl ether by mass.

2.03 JACKETS

A. PVC Plastic Valve and Fitting Covers
1. Manufacturers:
a. Johns Manville CorporationZeston 2000 Series
b. Knauf Proto
c. Speedline
d. Substitutions: See Section 01 6000 - Material and Equipment.
2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil.
e. Connections: Pressure sensitive color matching vinyl tape, tacks or welding adhesive.

B. Fiberglass Valve Covers
1. Description: Woven fiberglass jacketing around 2” thick fiberglass batt.
2. Attachment: Stainless steel wire and lacing hooks.

2.04 INSERTS AND SHIELDS

A. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

B. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

C. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

D. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive.

2. Insulate valves and fittings, including flanges, with PVC covers or fiberglass batt and woven fiberglass insulation jacketing.

E. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Insert location: Between support shield and piping and under the finish jacket.

F. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

3.03 SCHEDULES

A. Plumbing Systems:
1. Domestic Hot Water Supply in Recirculating Systems:
a. Glass Fiber Insulation:
1) Pipe Size Range: All sizes
2) Thickness: one inch.
2. Domestic Hot Water Supply in Non-recirculating Systems:
a. Glass Fiber Insulation:
1) Pipe Size Range: All sizes.
2) Thickness: Half inch, for first 8 feet from water heater or storage tank.
3. Domestic Hot Water Return (recirculation):
a. Glass Fiber Insulation:
1) Pipe Size Range: All sizes.
2) Thickness: One inch.
4. Domestic Cold Water, above grade:
a. Glass fiber insulation: 0.5 inch thick.

END OF SECTION

SECTION 22 1005

PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.
   1. Domestic water.
   2. Gas.

1.02 RELATED REQUIREMENTS

A. Section 09 9000 - Painting and Coating.

B. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

C. Section 22 0553 - Identification for Plumbing Piping and Equipment.

D. Section 22 0719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; The American Society of Mechanical Engineers; 2011.

B. ASME B16.4 - Gray Iron Threaded Fittings; The American Society of Mechanical Engineers; 2011.

C. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2014 (ANSI/ASME B31.9).

D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

E. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2013.

F. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.

G. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2010.

H. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2002 (Reapproved 2010).

I. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.

J. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2013.

K. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2012.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Project Record Documents: Record actual locations of valves.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Material and Equipment, for additional provisions.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints: ASTM B32, alloy Sn95 solder.

B. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized, using one of the following joint types:
   1. Threaded Joints: ASME B16.4 cast iron fittings.

2.03 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: NFPA 54, threaded or welded to ASME B31.1.

2.04 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 2 inches and Under:
   1. Ferrous pipe: Class 150 malleable iron threaded unions.
   2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 2 inches:
   1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.05 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
   4. Vertical Pipe Support: Steel riser clamp.

B. Plumbing Piping - Water:
   1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
   2. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
   3. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.06 GLOBE VALVES

A. Manufacturers:
   1. Hammond
   2. Conbraco Industries: www.apollovalves.com.
   3. Nibco, Inc: www.nibco.com.
   4. Milwaukee Valve Company: www.milwaukeevalve.com.

B. Up To and Including 2 inches:

1. MSS SP-80, Class 125, bronze body, bronze trim, handwheel, bronze disc, solder ends. Hammond IB440 (threaded) or IB418 (soldered).

C. Over 2 inches:
1. MSS SP-85, Class 125, iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor. Hammond IR116.

2.07 BALL VALVES

A. Manufacturers: Hammond as noted below, Apollo, Nibco, Milwaukee or approved.

B. Construction, 3 inches and smaller: 600 WOG, 150 SWP, 2 piece body style, full port, brass tunneled ball, reinforced TFE seats, hex gland follower, brass body of ASTM B283, blow-out proof stem, lever handle. Hammond 8901 (threaded) or 8911 (soldered).

2.08 PLUG VALVES FOR GAS SERVCE

A. Manufacturers: A.Y. McDonald, Resun, or approved.

B. Bronze body and plug manually operated low pressure natural or propane gas valve for use indoors on house piping system between the meter oulet and the inlet connection of the gas appliance at ambient temperatures of 32 to 125 degrees Fahrenheit. AGA approved. Lever handle with check, threaded inlet and outlet.

C. Size: To 2 inch.

2.09 GAS COCKS

A. Size 1 inch and under: 2 psi, brass body, TFE seat, lever handler, chrome plated ball; Hammond 875, Milwaukee or approved.

2.10 SEISMIC GAS SHUT-OFF VALVES

A. Manufacturers: Koso Model VB314F, or approved.

B. Description: Line size valve designed to shut off flow of gas when subjected to horizontal, sinusoidal oscillation; manual reset; minimal pressure drop; positive closure, soft seal seating; visual open-close indicator

C. Orientation: Vertical up.

D. Listings: UL, ASCE 25-97

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 0719.

G. Provide access where valves and fittings are not exposed.

H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

I. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 9000.

J. Install valves with stems upright or horizontal, not inverted.

K. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

L. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

M. Sleeve pipes passing through partitions, walls and floors.

N. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

O. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Support horizontal piping with hanger spacing in compliance with Code.
   3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Provide copper plated hangers and supports for copper piping.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Install globe valves for throttling, bypass, or manual flow control services.

E. Provide plug valves in natural gas systems for shut-off service.

3.05 TOLERANCES

A. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.06 SERVICE CONNECTIONS

A. Provide new gas service . Gas service distribution piping to have initial minimum pressure of 7 inch wg. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

END OF SECTION

SECTION 22 1006

PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gas pressure regulators

1.02 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

D. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Material and Equipment, for additional provisions.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GAS PRESSURE REGULATORS

A. Manufacturers: Sensus Model 243

B. Description: Large capacity, general purpose gas pressure regulator, for 5 psi inlet pressure, outlet pressure 7-11 inches wc, intended for natural gas systems.

C. Performance:
   1. Maximum inlet pressure 125 psi
   2. Outlet pressure: 3-1/2 inch to 2 psi outlet pressure
   3. Temperature: -20F to 150F
   4. Relief: Requires vent.

D. Control Pressure Rating: Select orifice for 60 psi.

E. Comply with NW Natural requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 22 3000

PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water heaters.

1.02 RELATED REQUIREMENTS

A. Products and Execution defined in this Section shall be commissioned. Refer to Sections 23 08 00 and 01 91 13 for scope of work and responsibilities related to commissioning.

1.03 REFERENCE STANDARDS

A. ANSI Z21.10.1 - Gas Water Heaters - Volume I - Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less; 2011.

B. ANSI Z21.10.3 - Gas Water Heaters - Volume III - Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous Water Heaters; 2011.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittals procedures.

B. Product Data:
   1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
   2. Provide electrical characteristics and connection requirements.

C. Project Record Documents: Record actual locations of components.

D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

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

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Material and Equipment, for additional provisions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 CERTIFICATIONS

A. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1 or ANSI Z21.10.3, as applicable, in addition to requirements specified elsewhere.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.07 WARRANTY

A. See Section 01 7000 - Contract Closeout, for additional warranty requirements.

B. Provide five year manufacturer parts and labor warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 HIGH EFFICIENCY GAS FIRED WATER HEATER

A. Manufacturers: Lochinvar Armor X2 Model AWN1300 (Basis of Design), Rheem Advantage Plus, Bradford White EF, A.O. Smith Cyclone, or approved equal with equivalent or better performance.
   1. Type: Automatic, natural gas-fired, direct-vent, closed combustion, vertical water heater.
   2. Performance: As scheduled.

3. Controls: Solid state electronic immersion thermostat, on-board diagnostic indicator lights, negative pressure gas valve combined with power-air blower to maintain uniform gas/air mixture.

B. Thermal Efficiency: Minimum 94%.

C. Accessories:
   1. Condensate neutralizing filter: 2” schedule 40 PVC pipe with ph neutralizing media (limestone pebbles) and ½” NPT and ½” barb fittings.
   2. Provide roof vent as indicated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

END OF SECTION

SECTION 23 0513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single phase electric motors.

B. Three phase electric motors.

1.02 RELATED REQUIREMENTS

A. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

B. Products and Execution defined in this Section shall be commissioned. Refer to Sections 23 08 00 and 01 91 13 for scope of work and responsibilities related to commissioning.

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc.; 1990 (Reapproved 2008).

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; Institute of Electrical and Electronic Engineers; 2004.

C. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2011.

D. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.

D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

E. Operation Data: Include instructions for safe operating procedures.

F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE

A. Conform to NFPA 70.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering.

1.07 WARRANTY

A. See Section 01 7000 - Contract Closeout, for additional warranty requirements.

B. Provide five year manufacturer warranty for motors larger than 20 horsepower.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Lincoln Motors: www.lincolnmotors.com.

B. Baldor Electric Company: www.baldor.com.

C. Reliance Electric/Rockwell Automation: www.reliance.com.

D. Substitutions: See Section 01 6000 - Material and Equipment.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service:
   1. Motors 1/2 HP and Smaller: 208 volts, single phase, 60 Hz.
   2. Motors Larger than 1/2 Horsepower: 460 volts, three phase, 60 Hz.

B. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 40 degrees C environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

D. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not conform to these specifications.

B. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.

2.04 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.05 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

I. Sound Power Levels: To NEMA MG 1.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 23 0549

VIBRATION & SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Intent:
   1. All mechanical equipment, piping and ductwork as noted on the equipment schedule or in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure .
   2. All mechanical equipment, piping and ductwork as noted on the equipment schedule, in the specification or as required by code shall be held in place during a seismic event.
   3. Seismic restraints for suspended components and equipment.

1.02 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2011.

B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2011.

C. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2002.

D. SMACNA (SRM) - Seismic Duct Restraint Manual; Sheet Me.al and Air Conditioning Contractors' National Association; 2008.

1.03 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Products and Execution defined in this Section shall be commissioned. Refer to Sections 23 08 00 and 01 91 13 for scope of work and responsibilities related to commissioning.

C. The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:
   1. Descriptive Data:
      a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
      b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.
      c. Shop Drawings:
         1) Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
         2) Provide all details of suspension and support for ceiling hung equipment.
         3) Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe shall be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals shall include spacing, static loads and seismic loads at all attachment and support points.
         4) Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
      d. Seismic Certification and Analysis:
         1) Seismic restraint calculations shall be provided for all connections of equipment to structure. Calculations shall be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
         2) All restraining devices shall have a preapproval number from California OSHPD or another recognized government agency showing maximum restraint ratings. Where pre-approved devices are not available, submittals based on independent testing or calculations stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location are required.

D. Contractor shall provide to the City of Salem Building and Permit Services Department as Supplemental Information all seismic details and calculations for equipment required as indicated. This information is required before Permits can be issued. Any additional permit fees will be covered by County. Where details are the same at multiple installations, copies may be submitted. Where new roof curbs are installed, details and calculations shall include attachment of curb to structure as well as attachment of equipment to curb. Where adaptor curbs are installed details and calculations shall include attachment of adaptor curb to existing curb as well as attachment of equipment to adaptor curb.

1.04 REGULATORY REQUIREMENTS

A. Typical Applicable Codes and Standards
   1. Seismic design shall be in accordance with the 2014 Oregon Structural Specialty Code.
   2. ACSE 7-05 as referenced in OSSC 2014.

1.05 MANUFACTURER'S RESPONSIBILITY

A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:
   1. Determine vibration isolation and seismic restraint sizes and locations.
   2. Provide vibration isolation and seismic restraints as scheduled or specified.
   3. Provide calculations and materials if required for restraint of non-isolated equipment.
   4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Vibration isolators and seismic restraints described in this section shall be the product of a single manufacturer.

B. Mason Industries, as basis of design: www.mason-ind.com

C. CalDyn: www.caldyn.com

D. Kinetics Noise Control: www.kineticsnoise.com

E. Substitutions: See Section 01 6000 - Material and Equipment.

2.02 SEISMIC RESTRAINTS FOR SUSPENDED COMPONENTS AND EQUIPMENT

A. Comply with:
   1. ASHRAE Handbook - HVAC Applications
   2. SMACNA - Seismic Duct Restraint Manual

B. Cable Restraints:
   1. Wire Rope: Steel wire strand cables sized to resist seismic loads in all lateral directions.
   2. Protective Thimbles: Eliminates potential for dynamic cable wear and strand breakage.
   3. Size: Based on the lesser of cable capacity or anchor load taking into account bracket geometry.
   4. Connections:
      a. Use overlapping wire rope U clips, cable clamping bolts, swaged sleeves or seismically rated tool-less wedge insert lock connectors.
      b. Internally brace clevis hanger bracket cross bolt to prevent deformation.
   5. Vertical Suspension Rods: Attach required bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.

C. Rigid Restraints:
   1. Structural Element: Sized to resist seismic loads in all lateral directions and carry both compressive and tensile loading.
   2. Size: Based on the lesser of cable capacity or anchor load taking into account bracket geometry.
   3. Connections: Internally brace clevis hanger bracket cross bolt to prevent deformation.

4. Static Support System: Anchorage capable of carrying additional tension loads generated by the vertical component of the rigid brace compression which is additive to any static load requirements on the system.
5. Vertical Suspension Rods: Attached required bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.

PART 3 - EXECUTION

3.01 GENERAL

A. All vibration isolators and seismic restraint systems shall be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.

B. Installation of vibration isolators and seismic restraints shall not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.

C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.

D. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor’s expense.

E. All mechanical equipment, piping and ductwork as noted on the equipment schedule, in the specification or as required by code shall be held in place during a seismic event.

3.02 SEISMIC BRACING REQUIREMENTS

A. Mechanical and electrical components shall meet the requirements of OSSC 2014 as noted in this section.

B. Requirements vary for systems with Ip=1.0 or 1.5. All components shall be assigned a component importance factor, Ip equal to 1.0 except the component importance factor Ip shall be taken as 1.5 where any of the following conditions apply:
1. The component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems.
2. The component contains hazardous materials.
3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.

Occupancy Categories are defined in OSSC 2014 Table 1604.5

C. For the purpose of this project ductile pipe is copper, steel, aluminum and cast iron no-hub pipe joined with approved elastomeric couplings.

D. Components suspended from above are not required to meet the requirements of this section provided that they cannot be damaged or cannot damage any other component when subject to seismic motion and they have ductile or articulating connections to the structure at the point of attachment. The gravity design load for these items shall be three times their operating load.

E. Seismic restraints can be excluded from the following when Ip=1.0:
1. Mechanical and electrical components where flexible connections are provided between the components and associated ductwork, piping and conduit, and the system components are mounted at 4 ft. or less above floor or roof level and weigh 400 lbs. or less.
2. Mechanical and electrical components weighing 75 lbs. or less where flexible connections are provided between the components and associated ductwork, piping and conduit.
3. Piping, ductwork and electrical distribution systems weighing 5 lbs./ft or less where flexible connectors are provided between the component and the piping, ductwork or electrical distribution system.
4. Suspended HVAC ducts provided they meet either of the following conditions for the entire run of duct, the hangers are 12 in. or less in length from the top of duct to the supporting structure detailed to avoid significant bending to the hangers or their connections or the cross-sectional area is less than 6 square feet .

5. Ductile piping with a nominal pipe size of 3 in. or less.

F. Seismic restraints can be excluded from the following when Ip=1.0 or 1.5:
   1. Equipment items installed in-line with the duct system (e.g. fans) with an operating weight equal to or less than 75 lbs. Unbraced piping attached to in-line equipment shall be provided with adequate flexibility to accommodate differential displacements.
   2. Piping supported by rod hangers provided that all hangers in the pipe run are 12 in. or less in length from the top of the pipe to the supporting structure and the pipe can accommodate the expected deflections. Rod hangers shall not be constructed in a manner that would subject the rod to bending moments.

G. Additional requirements for ductwork systems designated with an Ip=1.5:
   1. In addition to attachment and supports, ductwork systems designated as having an Ip=1.5 themselves shall be designed to meet the force and displacement requirements of this section.
   2. HVAC duct systems fabricated and installed according to approved standards meet the lateral bracing requirements of this section, include brace exclusions for ductwork under 6 sq. ft. area, ductwork supported 12” or less from the structure.

H. Additional requirements for piping systems designated with an Ip=1.5:
   1. Seismic braces can be excluded from ductile piping with Ip=1.5 and a nominal pipe size of 1 in. or less where provisions are made to protect the piping from impact of larger piping or other equipment.
   2. In addition to attachment and supports, piping systems designated as having an Ip=1.5 themselves shall be designed to meet the force and displacement requirements of this section.
   3. Piping designated as having an Ip=1.5, but not designed in accordance with ASME B31 shall meet the maximum stress levels shown in ASCE 7-05 and shall have adequate flexibility between support attachment points to the structure, ground, equipment or other piping.

I. Consider additional Fp factors:
   1. The resulting seismic force calculated from the above equations and tables is based on design strength loads. Initial use of these forces conflicts with the data available for the anchorage components used to resist the seismic forces that are based on allowable stress design (working stress design). Unless design strength values for anchor components are available, divide the resulting seismic force by 1.4 before designing the anchoring component.
   2. Components mounted on vibration isolation systems shall have bumper restraint or snubber in each horizontal direction. If the maximum clearance (air gap) between the equipment support frame and the restraint is greater than 1/4” the design force shall be taken as 2xFp. If the maximum clearance specified on the construction documents is 1/4", the design force may be taken as Fp .
   3. Where component anchorage is provided by shallow expansion anchors, shallow chemical anchors or shallow cast-in-place anchors (where embedment is less than 8xD) a value of Rp=1.5 shall be used.
   4. Anchors embedded in concrete shall be designed for 1.3 times the force.

J. Consider additional requirements:
   1. The design strength of anchors in concrete shall be determined in accordance with ACI-318-02; the only post-installed anchors currently meeting ACI-318-02 requirements are Hilti HDA, HSL and Kwik Bolt TZ.
   2. Expansion anchors shall not be used for mechanical equipment rated over 10 hp unless vibration isolators are provided.
   3. Mechanical and electrical components shall meet the force and seismic relative displacement requirements. Design drift can be taken as 1% of the story height. For example, differential motion from floor to ceiling for a 20’ story height is 2.4 inches. Suspended piping and ductwork attached to floor mounted equipment shall have the

inherent flexibility or flexible connectors to allow differential motion without overloading the component connection.

4. Mechanical and electrical components shall be designed to resist seismic forces. Components with an Ip=1.5 which shall remain operable shall demonstrate operability by shake table testing or experience data. The manufacturer's certificate of compliance shall be submitted to the authority having jurisdiction. Additional requirements for a quality assurance plan, special inspection and certification requirements are in OSSC 2014.

3.03 EQUIPMENT SCHEDULE

A. Base mounted equipment over 400 pounds: Provide seismic attachment to structure or roof curb.

B. Suspended Mechanical Equipment:
   1. Provide supports and bracing to resist seismic design force in any direction.
   2. Provide flexible connections between equipment and interconnected piping.
   3. Brace equipment hung from spring mounts using cable or other bracing that will not transmit vibration to the structure.
   4. Use of proprietary restraint systems with a certificate of compliance, verified and listed by an accredited inspection body is acceptable (pending shop drawing approval), as an alternative to project specific seismic bracing design.

END OF SECTION

SECTION 23 0553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.02 RELATED REQUIREMENTS

A. Products and Execution defined in this Section shall be commissioned. Refer to Sections 23 08 00 and 01 91 13 for scope of work and responsibilities related to commissioning.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Automatic Controls: Tags. Key to control schematic.

C. Control Panels: Nameplates.

D. Heat Transfer Equipment: Nameplates.

E. Instrumentation: Tags.

F. Major Control Components: Nameplates.

G. Piping: Pipe markers.

H. Thermostats: Nameplates.

I. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.02 NAMEPLATES

A. Manufacturers:
   1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
   2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   3. Seton Identification Products: www.seton.com.
   4. Substitutions: See Section 01 6000 - Material and Equipment.
   5.

B. Letter Color: White.

C. Letter Height: 1/4 inch.

D. Background Color: Black.

E. Plastic: Conform to ASTM D709.

2.03 TAGS

A. Manufacturers:
   1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
   2. Brady Corporation: www.bradycorp.com.
   3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   4. Seton Identification Products: www.seton.com.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradycorp.com.
   2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
   3. MIFAB, Inc.: www.mifab.com.
   4. Seton Identification Products: www.seton.com.

B. Color: Conform to ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Color code as follows:
   1. Heating, Cooling: Green with white letters.

2.05 CEILING TACKS

A. Manufacturers:
   1. Craftmark: www.craftmarkid.com.

B. Description: Steel with 3/4 inch diameter color coded head.

C. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Use tags on piping 3/4 inch diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.

3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

F. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of refrigerating systems.

C. Measurement of final operating condition of HVAC systems.

D. Pre-construction Testing and documentation of existing systems operating conditions.

E. Commissioning activities.

1.02 RELATED REQUIREMENTS

A. Products and Execution defined in this Section shall be commissioned. Refer to Sections 23 08 00 and 01 91 13 for scope of work and responsibilities related to commissioning.

1.03 REFERENCE STANDARDS

A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council; 2002.

B. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2008.

C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; National Environmental Balancing Bureau; 2005, Seventh Edition.

D. SMACNA 1780 - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association; 2002.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit to Architect.
   2. Submit to the Commissioning Authority.
   3. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
   4. Include at least the following in the plan:
      a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      c. Identification and types of measurement instruments to be used and their most recent calibration date.
      d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      e. Final test report forms to be used.
      f. Expected problems and solutions, etc.
      g. Details of how TOTAL flow will be determined; for example:
         1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.

h. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
i. Confirmation of understanding of the outside air ventilation criteria under all conditions.
j. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
k. Method of checking building static and exhaust fan and/or relief damper capacity.
l. Methods for making coil or other system plant capacity measurements, if specified.
m. Time schedule for TAB work to be done in phases (by floor, etc.).
n. Time schedule for deferred or seasonal TAB work, if specified.
o. False loading of systems to complete TAB work, if specified.
p. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
q. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
r. Procedures for formal progress reports, including scope and frequency.
s. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Field Logs: Submit at least once a week to Construction Manager.

E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

F. Progress Reports.

G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Submit under provisions of Section 01 4000.
2. Submit to the Construction Manager within two weeks after completion of testing, adjusting, and balancing.
3. Revise TAB plan to reflect actual procedures and submit as part of final report.
4. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
5. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
6. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
7. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
8. Units of Measure: Report data in I-P (inch-pound) units only.
9. Include the following on the title page of each report:
a. Name of Testing, Adjusting, and Balancing Agency.
b. Address of Testing, Adjusting, and Balancing Agency.
c. Telephone number of Testing, Adjusting, and Balancing Agency.
d. Project name.
e. Project location.
f. Project Architect.
g. Project Engineer.
h. Project Contractor.
i. Project altitude.
j. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
   1. AABC MN-1, AABC National Standards for Total System Balance.
   2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
   3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
   4. SMACNA 1780.
   5. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work on renovated sytems after completion of existing systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Having minimum of three years documented experience.
   3. Certified by one of the following:
      a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
      b. NEBB, National Environmental Balancing Bureau: www.nebb.org.
      c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

F. Pre-Qualified TAB Agencies:
   1. AIR Inc..
   2. Neudorfer, Inc..
   3. Substitutions: See Section 01 6000 - Material and Equipment.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
   10. Air outlets are installed and connected.
   11. Duct system leakage is minimized.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

3.07 COMMISSIONING

A. See Sections 01 9113 and 23 0800 for additional requirements.

B. Perform prerequisites prior to starting commissioning activities.

C. Fill out Prefunctional Checklists for:
   1. Air side systems.
   2. Water side systems.

D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.

E. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for 100 percent of the air handlers plus a random sample equivalent to 25 percent of the final TAB report data as directed by Commissioning Authority.
   1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
   2. Use the same test instruments as used in the original TAB work.
   3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
   4. For purposes of re-check, failure is defined as follows:
      a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
      b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
      c. Temperatures: Deviation of more than one degree F.
      d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
      e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
   5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler.

F. In the presence of the Commissioning Authority, verify that:
   1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
   2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
   3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.08 SCOPE

A. Test, adjust, and balance the following:

1. Air Cooled Refrigerant Heat Recovery Units
2. Packaged Roof Top Energy Recovery Ventilator
3. Air Coils
4. Air Handling Units
5. Fans

3.09 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
1. Manufacturer
2. Model/Frame
3. HP/BHP
4. Phase, voltage, amperage; nameplate, actual, no load
5. RPM
6. Service factor
7. Starter size, rating, heater elements
8. Sheave Make/Size/Bore

B. V-Belt Drives:
1. Identification/location
2. Required driven RPM
3. Driven sheave, diameter and RPM
4. Belt, size and quantity
5. Motor sheave diameter and RPM
6. Center to center distance, maximum, minimum, and actual

C. Cooling Coils:
1. Identification/number
2. Location
3. Service
4. Manufacturer
5. Air flow, design and actual
6. Entering air DB temperature, design and actual
7. Entering air WB temperature, design and actual
8. Leaving air DB temperature, design and actual
9. Leaving air WB temperature, design and actual
10. Saturated suction temperature, design and actual
11. Air pressure drop, design and actual

D. Heating Coils:
1. Identification/number
2. Location
3. Service
4. Air flow, design and actual
5. Water flow, design and actual
6. Water pressure drop, design and actual
7. Entering water temperature, design and actual
8. Leaving water temperature, design and actual
9. Entering air temperature, design and actual
10. Leaving air temperature, design and actual
11. Air pressure drop, design and actual

E. Air Moving Equipment:
1. Location
2. Manufacturer
3. Model number
4. Serial number
5. Arrangement/Class/Discharge

6. Air flow, specified and actual
7. Return air flow, specified and actual
8. Outside air flow, specified and actual
9. Total static pressure (total external), specified and actual
10. Inlet pressure
11. Discharge pressure
12. Sheave Make/Size/Bore
13. Number of Belts/Make/Size
14. Fan RPM

F. Return Air/Outside Air:
1. Identification/location
2. Design air flow
3. Actual air flow
4. Design return air flow
5. Actual return air flow
6. Design outside air flow
7. Actual outside air flow
8. Return air temperature
9. Outside air temperature
10. Required mixed air temperature
11. Actual mixed air temperature
12. Design outside/return air ratio
13. Actual outside/return air ratio

G. Duct Traverses:
1. System zone/branch
2. Duct size
3. Area
4. Design velocity
5. Design air flow
6. Test velocity
7. Test air flow
8. Duct static pressure
9. Air temperature
10. Air correction factor

H. Air Distribution Tests:
1. Air terminal number
2. Room number/location
3. Terminal type
4. Terminal size
5. Area factor
6. Design velocity
7. Design air flow
8. Test (final) velocity
9. Test (final) air flow
10. Percent of design air flow

END OF SECTION

SECTION 23 0713
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Duct Liner.

1.02 RELATED REQUIREMENTS

A. Section 23 0553 - Identification for HVAC Piping and Equipment.

B. Products and Execution defined in this Section shall be commissioned. Refer to Sections 23 08 00 and 01 91 13 for scope of work and responsibilities related to commissioning.

1.03 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

B. ASTM C553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.

D. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 1985 (Reapproved 2007).

E. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2012.

F. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2008.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2013.

I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2013.

J. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

K. SMACNA 1966 - HVAC Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. Knauf Insulation: www.knaufusa.com.
   2. Johns Manville Corporation: www.jm.com.
   3. Owens Corning Corporation: www.ocbuildingspec.com.
   4. CertainTeed Corporation: www.certainteed.com.
   5. Substitutions: See Section 01 6000 - Material and Equipment

B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Maximum Water Vapor Sorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   3. Secure with pressure sensitive tape.

2.03 DUCT LINER

A. Manufacturers:
   1. Knauf Insulation: www.knaufusa.com.
   2. Johns Manville Corporation: www.jm.com.
   3. Owens Corning Corp: www.owenscorning.com.
   4. CertainTeed Corporation: www.certainteed.com.

B. Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
   1. Fungi Resistance: ASTM G21.
   2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
   3. Service Temperature: Up to 250 degrees F.
   4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.
   5. Minimum Noise Reduction Coefficients:
      a. 1/2 inch Thickness: 0.30.
      b. 1 inch Thickness: 0.45.
      c. 1-1/2 inches Thickness: 0.60.
      d. 2 inch Thickness: 0.70.

C. Adhesive: Waterproof, fire-retardant type, ASTM C916.

D. Liner Fasteners: Galvanized steel, impact applied with integral head.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated ducts conveying air below ambient temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Finish with tape and vapor barrier jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated ducts conveying air above ambient temperature:
   1. Provide with or without standard vapor barrier jacket.
   2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Duct and Plenum Liner Application:
   1. Adhere insulation with adhesive for 90 percent coverage.
   2. Secure insulation with mechanical liner fasteners. Refer to SMACNA 1966 for spacing.
   3. Seal and smooth joints. Seal and coat transverse joints.
   4. Seal liner surface penetrations with adhesive.

END OF SECTION

SECTION 23 0719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 23 2300 - Refrigerant Piping: Placement of inserts.

B. Products and Execution defined in this Section shall be commissioned. Refer to Sections 23 08 00 and 01 91 13 for scope of work and responsibilities related to commissioning.

1.03 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.

C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

D. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2013.

E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2013.

F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2012.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2013.

I. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Aeroflex USA, Inc: www.aeroflexusa.com.
   2. Armacell LLC: www.armacell.us.
   3. K-Flex USA LLC: www.kflexusa.com.
   4. Substitutions: See Section 01 6000 - Material and Equipment

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.
   1. Minimum Service Temperature: -40 degrees F.
   2. Maximum Service Temperature: 220 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.03 JACKETS

A. PVC Plastic.
   1. Manufacturers:
      a. Johns Manville Corporation: www.jm.com.
   2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil.
      e. Connections: Brush on welding adhesive.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
   1. Thickness: 0.016 inch sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch laps.
   4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. Glass fiber insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

G. Inserts and Shields:
   1. Application: Piping 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert location: Between support shield and piping and under the finish jacket.
   4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. Mechanical contractor is responsible for providing firestopping system for all mechanical penetrations through all fire-rated walls.

I. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

3.03 SCHEDULE

A. VRF Systems:
   1. Refrigerant Suction: Flexible Elastomeric Cellular Insulation

END OF SECTION

SECTION 23 08 00

MECHANICAL SYSTEMS COMMISSIONING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS:

A. The purpose of this section is to specify Division 23 responsibilities in the commissioning process.

B. The systems to be commissioned are listed in Section 01 91 13.

C. Commissioning requires the participation of Division 23 Contractors to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 01 91 13. Division 23 shall be familiar with all parts of Section 01 91 13 and the commissioning plan issued by the CA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.2 RESPONSIBILITIES:

A. Mechanical, and Controls Contractors: The commissioning responsibilities applicable to each of the mechanical, and controls contractors of Division 23 are as follows (all references apply to commissioned equipment only):

Pre-Construction and Construction Period

1. Include and itemize the cost of commissioning in the contract price.
2. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
3. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Cx process.
4. Contractors shall provide the CA with normal cut sheets and shop drawing submittals of commissioned equipment.
5. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of start-up and functional trending procedures.
   a. This shall include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.
   b. The Commissioning Agent may request further documentation necessary for the commissioning process.
   c. This data request may be made prior to normal submittals.
6. Contractors shall assist (along with the design engineer) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
7. Provide limited assistance to the CA in preparing the specific functional testing procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
8. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the prefunctional checklists from the CA for all commissioned equipment. Submit to CA for review and approval prior to startup. Refer to Section 01 91 13 for further details on start-up plan preparation.

9. During the startup and initial checkout process, execute the mechanical-related portions of the prefunctional checklists for all commissioned equipment.
10. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.
11. Address current A/E punch list items before functional trending. Air and water TAB shall be completed with discrepancies and problems remedied before functional trending of the respective air- or water-related systems.
12. Provide skilled technicians to execute starting of equipment and to execute the functional trendings. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary trends, adjustments and problem-solving.
13. Implement functional trending under the direction of the CA. Assist the CA in interpreting the monitoring data, as necessary.
14. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA, CM and A/E and re-trend the equipment.

Warranty Period

1. Execute seasonal or deferred functional trending, witnessed by the CA, according to the specifications.
2. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal trending.

B. Mechanical Contractor: The responsibilities of the HVAC mechanical contractor, during construction and acceptance phases in addition to those listed in (A) are:
   1. Provide startup for all HVAC equipment, except for the building automation control system.
   2. Assist and cooperate with the TAB contractor and CA by:
      a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
      b. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.

C. Controls Contractor: Commissioning responsibilities of the controls contractor shall include setting up and initiating trends, other responsibilities listed in this Section and Section 23 09 13.

D. Mechanical Designer: Refer to Section 01 91 13 for the responsibilities of the mechanical designer.

1.3 RELATED SECTIONS:

A. Section 01 91 13 General Commissioning Requirements.

PART 2 PRODUCTS

2.1 TREND EQUIPMENT:

A. Controls Contractor shall provide all trend equipment necessary to fulfill the trending requirements of this Division.

B. Refer to Section 01 91 13 Paragraph 1.7 for additional Division 23 requirements.

PART 3 EXECUTION

3.1 SUBMITTALS:

A. Division 23 shall provide submittal documentation relative to commissioning as required in this Section Part 1, and Section 01 91 13.

3.2 STARTUP:

A. The HVAC mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities List in this section and in Section 01 91 13. Division 23 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional trending do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.

B. Functional trending is intended to begin upon completion of a system. Functional trending may proceed prior to the completion of systems or sub-systems at the discretion of the CA and CM. Beginning system trending before full completion does not relieve the Contractor from fully completing the system, including all prefunctional checklists as soon as possible.

3.3 TRENDING:

A. Refer to Section 23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

3.4 NON-CONFORMANCE AND APPROVALS:

A. Refer to Section 01 91 13 Paragraph 1.11 for specific details on non-conformance issues relating to prefunctional checklists and trends.

3.5 DEFERRED TESTING:

A. Refer to Section 01 91 13, Paragraph 1.15 for requirements of deferred testing.

3.6 WRITTEN WORK PRODUCTS

A. Written work products from the Contractors will consist of the start-up forms and Prefunctional Test Forms as described in this in and Section 01 91 13.

3.7 PREFUNCTIONAL TEST FORMS

A. Mechanical and Controls Contractors shall complete the appropriate portions of the Prefunctional Test Forms relating to their responsibilities for the equipment being commissioned. The following Prefunctional Test Forms provide an example of the information and work that can be expected on the forms.

Prefunctional Checklist

Building Automation System

Associated checklists: _____

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed. ___ List attached.

_____	_____	_____	_____
Mechanical Contractor	Date	Controls Contractor	Date
_____	_____	_____	_____
Electrical Contractor	Date	Sheet Metal Contractor	Date
_____	_____	_____	_____
TAB Contractor	Date	General Contractor	Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor, ____ = _____.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Owner's Representative	Date

2. Documentation submitted and approved:

__ manufacturer's cut sheets
__ installation and checkout manual and plan
__ full written sequences and list of all control strategies
__ written copy of all control parameters, settings and setpoints
__ O&M manual
__ performance data
__ operating manual
__ completed control drawings
__ design criteria
__ full descriptive points list

- ***Documentation complete as per contract documents.....___ YES ___ NO***

3. Model verification

	As Specified	As Submitted	As Installed
Manufacturer			
Model No.			
Serial No.	n/a	n/a	
CPU			
Monitor			
Other primary features:			

- ***The equipment installed matches the specifications for given trade .....___ YES ___ NO***

4. Initial Setup and Checkout

4.1. User Terminal Interface and Sub-Panel Checks

Check if Okay. Enter comment or note number if deficient.

Check	Y / N	Contr.
General appearance good, no apparent damage		
Equipment labels affixed		
Layout and location of control panels matches drawings		
Areas or equipment panels serve clear in control drawings		
Wiring labeled inside panels (to controlled components)		
Controlled components labeled/tagged		
BAS connection made to labeled terminal(s) as shown on drawings		
Shielded wiring used on electronic sensors		
110 volt AC power available to panel		
Psig compressed air available to panel (if applicable)		
Battery backup in place and operable		
Panels properly grounded		
Environmental conditions according to manufacturer's requirements		
Date and time correct		

- ***The above setup and checkout was successfully completed for given trade .....___ YES ___ NO***

4.2. Device and Point Checkout

The following procedures are required to be performed and documented for each and every point in the control system. The following procedures are minimum requirements. The control contractor is encouraged to identify better and more comprehensive checkout procedures in their submitted plan. These procedures are not a substitute for the manufacturer's recommended start-up and checkout procedures, but are to be combined with them, as applicable. The documentation may be provided on the vendor's stock form, as long as all the information in the sample table below can be clearly documented on the form.

Similar checkout and calibration requirements are found on the equipment prefunctional checklists. Redundant documentation is not required. Cross reference, by name and form number, to other forms that contain documentation left blank on the current form.

Procedures

1. [Wire] Verify that the wiring is correct to each point.
2. [Actu] If the device is or has an actuator, verify full free movement through its full range.
3. [Addr] Verify that the software address is correct.
4. [Load] For devices with a controller, verify that current software program with proper setpoints has been downloaded.
5. [DevCal] Device stroke/range calibration. This applies to all controlled valves, dampers, fans, pumps, actuators, etc. Simulate maximum and minimum transmitter signal values and verify minimum and maximum controller output values and positively verify each and every control device minimum and maximum stroke and capacity range. Follow procedure 6.2 below.
6. [SensLoc] Verify that all sensor locations are appropriate and away from causes of erratic operation.
7. [SensCal] Sensor calibration. Calibrate or verify calibration of all sensors and thermostats, including temperature, pressure, flow, current, kW, rpm, Hertz, etc. Verify that the sensor readings in the control system are within the sensor accuracies specified in this section, using hand-held or other external measuring instruments. Follow procedure 6.1 below.
8. [OperCk] For controlled devices (dampers, valves, actuators, VAV boxes, etc.), after mechanical equipment control becomes operational, perform an operational test of each control loop. Follow procedure 6.2 below. Operational checks are preparatory to the later *functional testing*.

Other Abbreviations:

[BAS] ..... Building automation system or gage-read value.
[Instru] .... Instrument (calibrated) read value.
[Ofset] ..... Offset programmed into the point to correct the calibration.

--SAMPLE FORM-- Controls Checkout Documentation Table

Point ID	Object	Field Device Type	Hardware Checks			Load	Dev Cal	Sens Loc	SensCal			Final Check	
			Wire	Actu	Addr				BAS	Instru	Offset	Oper Ck	
			1	2	3	4	5	6	7	7	7	8	9
AI-1	**ZN-T (zone T)**	**PhJack**	√	**na**	√	**na**	**na**	√	**70.2F**	71.4F	+1.2F	**na**	
3-2a	**RA-DPR (damper)**	**PNEU**	√	√	√	**na**	√	**na**	**na**	**na**	**na**	√	

- ***The initial setup and checkout has been successfully completed as described in Section 4.2 and Section 6 and documented on attached forms.....___ YES ___ NO***

6. Sensor and Actuator Calibration [ ]

All field-installed temperature, relative humidity, CO, CO_2 and pressure sensors and gages, and all actuators (dampers and valves) shall be calibrated using the methods and tolerances given in the "Calibration and Leak-by Test Procedures" document. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed *in* a packaged unit at the factory with calibration certification provided need not be field calibrated. All calibrations shall be fully documented, including initial and final readings, offsets etc., on prefunctional checklist or other suitable forms.

-- END OF CHECKLIST --

Prefunctional Checklist

Duct and Duct Accessories

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed. ___ List attached.

_____ _____ _____ _____

Sheet Metal Contractor Date General Contractor Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor, ____ = _____.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____ _____ _____ _____

Commissioning Agent Date Owner's Representative Date

2. Requested documentation submitted

Check if Okay. Enter comment or note number if deficient.

Check	1	2	3
Manufacturer's cut sheets			
O&M manuals			
As Built Drawings provided w/ all deviations from original layout noted.			

- ***Documentation complete as per contract documents for given trade .....___ YES ___ NO***

3. Model verification **Contr =**

1 = as approved, 2 = as installed. Check if Okay. Enter note number if deficient.

		Fire Smoke Dampers	Note
	1		
Manuf.	2		
	1		
Model	2		

- ***The equipment installed matches the specifications for given trade .....___ YES ___ NO***

4. Installation Checks

Check if Okay. Enter comment or note if deficient.

Check		Note	Contr.
Building Wide General Installation			
Permanent labels affixed where called for per contract docs.			
Maintenance accesses for fire and balancing dampers acceptable.			
Smoke and fire dampers installed per contract docs (proper location, access doors, appropriate ratings verified)			
All dampers close tightly			
Duct joints sealed as called for in contract specifications			
No apparent severe duct restrictions			
Turning vanes in square elbows as per drawings			
Pressure leakage tests completed			
Branch duct control dampers operable			
Duct work installation completed and ready for TAB.			
Ducts cleaned as per contract documents			
Insulation of ductwork completed as per contract documents			
OSA intakes located away from pollutant sources & exhaust outlets			
No apparent severe duct restrictions			

Check if Okay. Enter comment or note if deficient.

Check		Note	Contr.
Connection between duct and AHU tight and in good condition			
Duct smoke detectors installed.			
Final			
All smoke/fire dampers are open to allow testing.			
Balancing dampers installed as per contract documents so to allow balancing to be completed following specified NEBB or AABC procedures and contract documents			

- ***The checklist items of Part 4 are all successfully completed for given trade.....___ YES ___ NO***

-- END OF CHECKLIST--

Prefunctional Checklist

Exhaust Fan #____

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items precludes safe and reliable functional tests being performed. ___ List attached.

_____ _____ _____ _____

Mechanical Contractor Date Controls Contractor Date

_____ _____ _____ _____

Electrical Contractor Date Sheet Metal Contractor Date

_____ _____

General Contractor Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor, ____ = _____.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____ _____ _____ _____

Commissioning Agent Date Owner's Representative Date

2. Requested documentation submitted

Check if Okay. Enter comment or note number if deficient.

Check	EF	Contr.
Manufacturer's cut sheets		
Performance data (fan curves, coil data, etc.)		
Installation and startup manual and plan		
Sequences and control strategies		
O&M manuals		

- ***Documentation complete as per contract documents for given trade .....___ YES ___ NO***

3. Model verification **Contr =**

1 = as specified, 2 = as submitted, 3 = as installed. Check if Okay. Enter note number if deficient.

		EF	Note
Manuf.	1		
	2		
	3		
Model	1		
	2		
	3		
Serial #	3		
CFM	1		
	2		
	3		
Sound Pwr Level @ 63, 250; 1K Hz	1		

- ***The equipment installed matches the specifications for given trade .....___ YES ___ NO***

4. Installation Checks

Check if Okay. Enter comment or note number if deficient.

Check	EF	Note	Contr.
Cabinet and General Installation			
Permanent labels affixed			
Casing condition good: no dents, leaks, door gaskets installed			
Mountings checked and shipping bolts removed			
Vibration isolators installed as called for in manufactures Instructions			
Equipment guards installed			
Pulleys aligned			
Belt tension correct			
Plenums clear of debris			
Fans rotate freely			
Fire and balance dampers installed			

Check if Okay. Enter comment or note number if deficient.

Check	EF	Note	Contr.
Backdraft dampers installed, per drawings, and operate freely			
Duct system complete			
Electrical			
Electrical connnections complete			
Disconnect switch installed			
Overload heaters in place			
Control connections complete			
Operational Checks			
Fan rotation correct			
Electrical interlocks verified			
Any fan status indicators functioning			
No unusual vibration or and noise			
Record full load running amps for each fan. _____rated FL amps x _____srvc factor = _____ (Max amps). Running less than max?			
Check voltage: Rate = _____ Actual = _____ Within 5%?			
The disconnect switch properly operates			
After 24 hours of operation, recheck belt tension and alignment			

- ***The checklist items of Part 4 are all successfully completed for given trade.....___ YES ___ NO***

-- END OF CHECKLIST--

3.8 FUNCTIONAL TEST FORMS

A. Mechanical and Controls Contractors shall assist the CA in completing the Functional Test Forms. The sample procedures displayed are to provide contractors with an example of a format and an indication of the rigor of the required testing and documentation for various equipment types. The CA will create and execute the Functional Tests with assistance from the Contractors. Assistance may consist of operating equipment and answering questions during the time Functional Testing is being performed. For illustrative purposes, the following Functional Test Forms have been included an example of the information and work that will be expected on the forms.

Functional Checklist
EF-6

Associated Equipment Including:
Exhaust Fan VFD

1. Participants

Party	Participation

Party filling out this form and witnessing testing _____

Date of test _____

2. Prerequisite Checklist

a. The following have been started up and startup reports and prefunctional checklists submitted and approved ready for functional testing:
__ AH-6

b. __ All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.

c. __ Test and balance (TAB) completed and approved for both exhaust fans.

d. __ All A/E punchlist items for this equipment corrected.

e. __ Safeties and operating ranges reviewed.

f. __ Test requirements and sequences of operation verified

g. __ Schedules and setpoints verified

h. __ **Control Program Review.** Review the software control program(s) for this equipment. Parameters, setpoints and logic sequences appear to follow the specified written sequences.

i. __ Record of All Values for Current Setpoints (SP), Control Parameters, Limits, Delays, Lockouts, Schedules, Etc.

Changed to Accommodate Testing:

Parameter	**Pre-Test Values**	**Returned to Pre-Test Values √**

3. Sensor Calibration Checks. Check the sensors listed below for calibration and adequate location. This is a sampling check of calibrations done during prefunctional checklisting.

Sensor & Location	Loc-atio n OK[1]	BAS Value	Instr. Meas'd Value	**Final** Gage or BAS Value	Pass Y/N?
Building DP					

[1]Sensor location is appropriate and away from causes of erratic operation.

5. Functional Testing Record

Functional Testing will include 2 weeks of contiguous Trend data that will show that the equipment is implementing the following sequences. If the system does not follow a sequence shown below, circle the corresponding "No" and indicate the "Note #" that explains why the system did not meet the sequence.

RELIEF FAN EF-3, 4, 5, 6, AND 15

Upon a request for a relief fan, the outdoor air damper shall open. Once the damper is open, the relief fan shall start. The relief fan VFD shall be controlled to maintain a space pressure of 0.05" (relative to outdoors) static pressure positive sensed by related space pressure sensor. Relief fans shall be energized during occupied mode and deenergized during unoccupied mode and when the fire alarm system is in alarm. The status of the fans shall be monitored by a Veris H-904 current transducer.

EF is enabled by what? _____

End switch for damper position operates correctly **Yes____** **No____**

Does fan start is the damper position switch shows damper Closed? **Yes____** **No____**

VFD is ramping up correctly? **Yes____** **No____**

What happens when power to VFD is lost and then returns?

_____

What happens when VFD is put in manual and then started?

_____

Check VFD at different outputs compared to DDC system

What is the min output _____Hz

Pressure sensing point is located where? _____

Pressure SP is_____in

Pressure PV is _____in

Fan is enabled after damper is completely open? Yes____ No____

Alarm is enabled when fan operation is not verified Yes____ No____

Trending has been enabled for points Yes____ No____

-- END OF CHECKLIST --

Functional Checklist

Pump P-5

1. Submittal / Approvals

All Prefunctional Tests have been received and approved from the following contractors.

Mechanical Contractor _____
Controls Contractor _____
Electrical Contractor _____
General Contractor _____

Date of Test: _____

Time: _____

Weather Conditions:_____

General Building Conditions: _____

Functional Test Participants

_____ : _____

_____ : _____

_____ : _____

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted
below.

_____ _____
Commissioning Agent Date

2. Model verification

as installed. Check if Okay. Enter note number if deficient.

	Data	Note
Manuf		
Model		
Serial #		
Motor Eff.		
Capacity		

- ***The equipment installed matches the specifications for given trade .....___ YES ___ NO***

3. Installation Checks

Check if Okay. Enter comment or note number if deficient.

Check	Y/N	Note
Cabinet and General Installation		
Permanent labels affixed.		
Unit mounted per manufactures instructions?		
Maintenance access acceptable for unit and components		
Clean up of equipment completed per contract documents		
Pump and motor lubricated per manufactures instructions		
Valves, and Piping		
Pipe fittings complete and pipes properly supported per drawings and specifications		
Pipes properly labeled		
Pipes properly insulated		
Piping system properly flushed		
Strainers cleaned since startup and flush		
Valves properly labled		
No leaking apparent around fittings		
Check to make sure air has been purged from system		
Pressure gauges installed and reading correctly		
Electrical and Controls		
Power disconnects in place and labeled		
Control system programmed and ready to test		
All control wiring complete and verified		

4. Operational Checks

1. Is only P-5 enabled? ___ ***YES*** ___ ***NO***
2. Make sure P-6 has been disabled
3. Sequence of operation for the pump has been verified with LIEBERT ___ ***YES*** ___ ***NO***
4. Command pump off through the control system. Does it shut off? ___ ***YES*** ___ ***NO***
5. Does the pump start when command on by the control system? ___ ***YES*** ___ ***NO***
6. Disable the pump through the HOA. Does the pump shut off and is an alarm broadcasted on the control system? ___ ***YES*** ___ ***NO***
7. Does the alarm reset after the pump is restarted ___ ***YES*** ___ ***NO***
8. Allow P-6 to be enabled.
9. Disable P-5 pump through HOA. Does CRU-2 shut down? ___ ***YES*** ___ ***NO***
10. Put P-5 HOA back into Auto position. Does CRU-2 start? ___ ***YES*** ___ ***NO***
11. Does the DDC system indicate status of pump on the graphics? ___ ***YES*** ___ ***NO***
12. Have the trends been setup for the pump operation? Is it being sampled At 5 minute sample rate? ___ ***YES*** ___ ***NO***

Record the following while P-5 is enabled.

.

Record the following information

Inlet Pressure _____psig

Outlet Pressure _____psig

-- END OF CHECKLIST --

Functional Checklist
Heat Recovery Unit #2

1. Participants

Party	Participation

Party filling out this form and witnessing testing _____
Date of test _____

2. Prerequisite Checklist

a. The following have been started up and startup reports and prefunctional checklists submitted and approved ready for functional testing:
__ Heating/Cooling Water System __ Water piping and valves

b. __ All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.

_____ _____
Controls Contractor Signature or Verbal Date

c. __ Piping system flushing complete and required reports approved.
d. __ Water treatment system complete and operational.
f. __ Test and balance (TAB) completed and approved for the hydronic systems and terminal units connected.
g. __ All A/E punchlist items for this equipment corrected.
i. __ Safeties and operating ranges reviewed.
j. __ Test requirements and sequences of operation verified
k. __ Schedules and setpoints verified
n. __ **Control Program Review.** Review the software control program(s) for this equipment. Parameters, setpoints and logic sequences appear to follow the specified written sequences.

o. __ Record of All Values for Current Setpoints (SP), Control Parameters, Limits, Delays, Lockouts, Schedules, Etc. Changed to Accommodate Testing:

Parameter	Pre-Test Values	Returned to Pre-Test Values √

3. Sensor Calibration Checks. Check the sensors listed below for calibration and adequate location. This is a sampling check of calibrations done during prefunctional checklisting.

"In calibration" means making a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) compared to the test instrument-measured value is within the tolerances specified in the prefunctional checklist requirements (_____). If not, install offset in BAS, calibrate or replace sensor. Use the same test instruments as used for the original calibration, if possible.

Sensor & Location	Loc-atio n OK[1]	**1st** Gage or BAS Value	Instr. Meas'd Value	**Final** Gage or BAS Value	Pass Y/N?
DAT					
RAT 1					
RAT 2					
Zone temperature					

Sensor & Location	Loc-atio n OK[1]	**1st** Gage or BAS Value	Instr. Meas'd Value	**Final** Gage or BAS Value	Pass Y/N?
Disch. SP					
OSAT 1					
OSAT 2					

[1]Sensor location is appropriate and away from causes of erratic operation.

4. Device Calibration Checks. The actuators or devices listed below checked for calibration. This is a spot check on a sample of the calibrations done during prefunctional checklisting and startup.

"In calibration" means observing a readout in the BAS and going to the actuator or controlled device and verifying that the BAS reading is correct. For items out of calibration or adjustment, fix now if easy, via an offset in the BAS, or a mechanical fix.

Device or Actuator & Location	**Procedure / State**	**1st** BAS Value	Site Observation	**Final** BAS Reading	Pas s Y/N
Cooling coil valve Position or command and Stroke*	1. Intermediate positions				
	2. Full open				
	3. Increase Signal (open)				
	4. Closed				
	5. Remove power (closed)				
Heating coil valve Position or command and Stroke*	1. Intermediate positions				
	2. Full open				
	3. Increase Signal (open)				
	4. Closed				
	5. Remove power (closed)				
Heat Pipe Dampers Inlet Air	1. Closed				
	2. Full open				
Heat Pipe Dampers OutletAir	1. Closed				
	2. Full open				
OSA and Exhaust Dampers	1. Closed				
	2. Full open				

* *Procedure 1.* Command valve to a few intermediate positions. Verify that readings in BAS reasonably correspond to the actual positions. For cooling coil valves (NC): *Procedure 2.* Lower space setpoint to 20F below space temperature. Verify BAS reading says CCV is 100% open. Visually verify valve is 100% open. *Procedure 3.* For pneumatic actuators, by override in the EMS, increase pressure to valve by 3 psi (do not exceed actuator rating). Verify valve stem & actuator position does not change. Restore to normal. *Procedure 4.* Set space setpoint to 20F above space temperature. Verify BAS reading says CCV is

closed. Visually verify valve is closed. *Procedure 5.* Remove control air or electricity from the valve and verify that the valve stem and actuator position do not change.
**1. Command damper closed and verify that damper is shut and BAS reads shut. 2. Do the same, commanding damper fully open.

6. Functional Testing Record

Functional Testing will include 2 weeks of contiguous Trend data that will show that the equipment is implementing the following sequences. If the system does not follow a sequence shown below, circle the corresponding "No" and indicate the "Note #" that explains why the system did not meet the sequence.

Response	Sequence	Note #
	HOA, Type 3: Heat Recovery Unit controlled by local panel HAND-OFF-AUTO switch: AUTO: Packaged system operates in accordance with system control programs, and internal control routines, subject to safeties. OFF: Supply and Exhaust fans inoperative. HAND: Supply and Exhaust fans on, subject to safeties.	
Works Correctly? Yes No	**Occupied / Unoccupied Hour Operation, Type 5:** System is constant volume and operates continuously when building is occupied. Outside and exhaust air dampers, bypass dampers, and heat recovery section shall operate in response to the manufacturer's control system supplied with the unit. Supply and exhaust fan, heating coil, and remaining components shall operate in response to the BAS in accordance with listed operational requirements to maintain set points, as read at local space sensors, subject to safeties.	
Works Correctly? Yes No	**Unoccupied Hour Operation:** System normally shut down during unoccupied hours, subject to signal from occupancy sensor in any toilet room served by this system. When occupancy sensor contact closes then start system and begin 20 minute timer. If occupancy sensor contact opens before 20 minute period elapses, then continue operation through 20 minute period. If 20 minute operation period is elapses before occupancy sensor contact opens, then continue operation until occupancy sensor contact opens.	
Works Correctly? Yes No	**Automatic Damper Control, Type 2:** The dampers operate in response to the manufacturers packaged controls. Automatic Outside, Exhaust, and Face & By-pass Dampers: Outside Air Damper: Two-position. Closed when HRU is not operating. Exhaust Air Dampers: Two-position. Closed when HRU is not operating. Heat Exchanger Face & By-pass Dampers: Modulating. Dampers shall modulate between full heat recovery and full	

Response	Sequence	Note #
	by-pass in accordance with supply air temperatures listed below and internal defrosting requirements. Face damper is normally open, by-pass damper is normally closed.	
Works Correctly? Yes No	**Heating Coil, Type 2:** Heating water control valve modulates to maintain supply air set point. Controlled by discharge air sensor, with 17 foot averaging element, through BAS. Set-point = 72 deg F. when outside temperature is below 61 deg F. Set-point = 70 deg F. when outside temperature is between 61 and 70 deg F. inclusive. Modulating valve closed to heat when outside temperature is above 70 deg F., or when space sensors call for cooling.	
Works Correctly? Yes No	**Cooling Coil, Type 2:** Modulating valve controlled to maintain specified supply air set point. Controlled by discharge air sensor, through BAS. Set-point = 78 deg F. when outside temperature is above 85 deg F. Set-point = 75 deg F. when outside temperature is between 75 and 85 deg F. inclusive. Modulating valve closed to cooling when outside temperature is below 65 deg F., and when system is in heating mode.	
Works Correctly? Yes No	**Low Limit Temperature Control, Type 3:** The supply air temperature sensor shall open the heating coil valve to full flow through the heating coil if discharge drops below 65 deg F. A low limit alarm will be annunciated at the BAS. System returns to "normal" operation when thermostat senses 70 deg F.	
Works Correctly? Yes No	**Freeze Protection, Type 1:** Discharge thermostat with 20 foot capillary stops the fans through their starter circuits, closes outside and relief air dampers, and opens the heating coil valve to full flow through coil if discharge drops below 38 deg F. The fans will not restart until the thermostat is manually reset.	
Works Correctly? Yes No	**Smoke Management Modes, Type 1 and Type 2.** Smoke Management, Type 1 (Smoke in Atrium): Smoke Management, Type 2 (Smoke in Areas Outside Atrium): Refer to Fire System Interlock and Emergency Sequence.	

END OF TEST

END OF SECTION

SECTION 23 2300
REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping.

B. Refrigerant.

1.02 RELATED REQUIREMENTS

A. Products and Execution defined in this Section shall be commissioned. Refer to Sections 23 08 00 and 01 91 13 for scope of work and responsibilities related to commissioning.

1.03 REFERENCE STANDARDS

A. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2013.

B. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes; The American Society of Mechanical Engineers; 2013.

C. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; The American Society of Mechanical Engineers; 2013.

D. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2014 (ANSI/ASME B31.9).

E. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2013.

F. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 2011 and errata.

G. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

C. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 PIPING

A. Copper Tube, 1 inch and larger: ASTM B280, Type K, H58 hard drawn .
   1. Fittings: ASME B16.22 wrought copper.
   2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.

B. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
   1. Fittings: ASME B16.26 cast copper.
   2. Joints: Flared.

C. Line sets between BC controller and indoor units:

1. Diamondback Twin-tube LineSets, in 15 through 100 foot lengths, consisting of twin soft copper tubes with 1/2 inch insulation and flare connections with flare nuts.
2. Tested to ASTM E243.

D. Pipe Supports and Anchors:
1. Provide hangers and supports that comply with MSS SP-58.
a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.
3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
4. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
5. Vertical Support: Steel riser clamp.
6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
7. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.02 VALVES

A. Ball Valves:
1. 7/8 inch size: Two piece forged brass body with teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 325 degrees F. Include Shrader valve for testing.
2. 1/4 to 5/8 inch size: Diamondback BV-series, with Shrader valve.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Refer to manufacturer's installation instructions for specific installation requirements.

C. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and avoid interference with use of space.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.5.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Provide ball valves at connection to each piece of equipment (including OU's, BC controllers, and IU's) except where service valves are integral to equipment.

END OF SECTION

SECTION 23 3100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

B. Casing and plenums.

1.02 RELATED REQUIREMENTS

A. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

B. Section 23 0713 - Duct Insulation: External insulation and duct liner.

C. Section 23 3300 - Air Duct Accessories.

D. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

E. Products and Execution defined in this Section shall be commissioned. Refer to Sections 23 08 00 and 01 91 13 for scope of work and responsibilities related to commissioning.

1.03 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.

F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association; 2012.

G. SMACNA 1972 - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.

H. SMACNA 1966 - HVAC Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide data for duct materials.

C. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of documented experience.

1.06 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.07 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to NFPA 90A standards.

B. All Ducts: Galvanized steel, unless otherwise indicated.

C. Low Pressure Supply (Heating Systems): 2 inch w.g. pressure class, galvanized steel.

D. Low Pressure Supply (System with Cooling Coils): 2 inch w.g. pressure class, galvanized steel.

E. Return and Relief: 1 inch w.g. pressure class, galvanized steel.

2.02 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   2. VOC Content: Not more than 250 g/L, excluding water.
   3. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E84.
   4. Products:
      a. Carlisle HVAC Products; Hardcast Iron-Grip 601 Water Based Duct Sealant: www.carlislehvac.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

C. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
   5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
   6. Other Types: As required.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA 1966 and as indicated.

B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

2.04 CASINGS

A. Fabricate casings in accordance with SMACNA 1966 and construct for operating pressures indicated.

B. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18 gage, 0.0478 inch expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.

C. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA 1966.

B. Install in accordance with manufacturer's instructions.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

E. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

G. Use double nuts and lock washers on threaded rod supports.

END OF SECTION

SECTION 23 3300

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air turning devices/extractors.

B. Backdraft dampers - metal.

C. Duct access doors.

D. Duct test holes.

E. Flexible duct connections.

F. Volume control dampers.

1.02 RELATED REQUIREMENTS

A. Section 23 3100 - HVAC Ducts and Casings.

B. Products and Execution defined in this Section shall be commissioned. Refer to Sections 23 08 00 and 01 91 13 for scope of work and responsibilities related to commissioning.

1.03 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.

B. SMACNA 1966 - HVAC Duct Construction Standards; 2005.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.

C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.

D. Project Record Drawings: Record actual locations of access doors and test holes.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

A. Manufacturers:
   1. Carlisle HVAC Products; Dynair Hollow Vane and Rail (Double Wall Vane): www.carlislehvac.com.
   2. Krueger: www.krueger-hvac.com.
   3. Ruskin Company: www.ruskin.com.
   4. Titus: www.titus-hvac.com.

B. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.02 BACKDRAFT DAMPERS - METAL

A. Manufacturers:
   1. Cesco, Inc: www.cescoproducts.com.
   2. Nailor Industries Inc: www.nailor.com.
   3. Ruskin Company: www.ruskin.com.

B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.03 DUCT ACCESS DOORS

A. Manufacturers:
   1. Acudor Products Inc: www.acudor.com.
   2. Elgen Manufacturing: www.elgenmfg.com.
   3. Nailor Industries Inc: www.nailor.com.
   4. Ruskin Company: www.ruskin.com.
   5. SEMCO Incorporated: www.semcoinc.com.

B. Fabricate in accordance with SMACNA 1966 and as indicated.

2.04 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
   1. Products:
   2. Carlisle HVAC Products; Dynair Test Port with Red Cap with O-Ring Seal: www.carlislehvac.com.

2.05 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:
   1. Carlisle HVAC Products; Dynair Connector Plus G90 Steel Offset Seam Neoprene Fabric: www.carlislehvac.com.
   2. Elgen Manufacturing: www.elgenmfg.com.
   3. Substitutions: See Section 01 6000 - Material and Equipment.

B. Fabricate in accordance with SMACNA 1966 and as indicated.

C. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
      a. Net Fabric Width: Approximately 2 inches wide.

2.06 VOLUME CONTROL DAMPERS

A. Manufacturers:
   1. Cesco Products: www.cescoproducts.com.
   2. Nailor Industries Inc: www.nailor.com.
   3. Ruskin Company: www.ruskin.com.
   4. Substitutions: See Section 01 6000 - Material and Equipment.

B. Fabricate in accordance with SMACNA 1966 and as indicated.

C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
   1. Fabricate for duct sizes up to 6 x 30 inch.
   2. Blade: 24 gage, 0.0239 inch, minimum.

D. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.
   1. Products:
      a. Carlisle HVAC Products; Dynair End Bearing Leak Resistant Sets: www.carlislehvac.com.
      b. Elgen Manufacturing Company; Snap-in Bushing: www.elgenmfg.com.
      c. Substitutions: See Section 01 6000 - Material and Equipment.

E. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
   3. Where rod lengths exceed 30 inches provide regulator at both ends.
   4. Products:
      a. Carlisle HVAC Products; Dynair Double Shear Rattle Free Quadrants 1/2 inch: www.carlislehvac.com.
      b. Substitutions: See Section 01 6000 - Material and Equipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA 1966. Refer to Section 23 3100 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

F. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

G. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 4000
HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Disposable panel filters.

B. Filter frames and housings.

C. Filter gages.

1.02 RELATED REQUIREMENTS

A. Products and Execution defined in this Section shall be commissioned. Refer to Sections 23 08 00 and 01 91 13 for scope of work and responsibilities related to commissioning.

1.03 REFERENCE STANDARDS

A. AHRI 850 - Performance Rating of Commercial and Industrial Air Filter Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2004.

B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2012.

C. UL 900 - Standard for Air Filter Units; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 PERFORMANCE REQUIREMENTS

A. Conform to AHRI 850 Section 7.4.
   1. Dust Spot Efficiency: Plus or minus 5 percent.

1.05 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions.

C. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Material and Equipment, for additional provisions.
   2. Extra Filters: One set of each type and size.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. American Filtration Inc: www.americanfiltration.com.

B. AAF International/American Air Filter: www.aafintl.com.

C. Camfil Farr Company: www.camfilfarr.com.

2.02 DISPOSABLE PANEL FILTERS

A. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.

B. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
   1. Nominal Size: Refer to Indoor Unit Schedule.
   2. Thickness: 2 inch.

C. Performance Rating:
   1. Face Velocity: 500 FPM.
   2. Initial Resistance: 0.15 inch WG.
   3. Recommended Final Resistance: 0.50 inches WG.

D. Casing: Cardboard frame.

2.03 FILTER FRAMES AND HOUSINGS

A. Basis of Design: Camfil Farr; Model: GlidePack MultiTrack 13, sized for 2" rigid filter.

B. General: Fabricate filter frames and supporting structures of 16 gage, 0.0598 inch galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.

C. Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters, size for 24"x24" filter media, minimum 2 inches thick.

D. Side Servicing Housings: Flanged for insertion into frame, of reinforced 16 gage, 0.0598 inch galvanized steel; access doors with continuous gasketing and positive locking devices on both sides; extruded aluminum tracks or channels for primary secondary filters with positive sealing gaskets.

2.04 FILTER GAGES

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com.
   2. H.O. Trerice Co: www.trerice.com.
   3. Weiss Instruments: www.weissinstruments.com.
   4. Substitutions: See Section 01 6000 - Material and Equipment.

B. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-0.5 inch WG, 2 percent of full scale accuracy.

PART 3 EXECUTION

3.01 INSTALLATION

A. Field install air cleaning devices in accordance with manufacturer's instructions. Provide sheet metal transition for connection of filter housing to fan coil unit.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Install filter gage static pressure tips upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

END OF SECTION

SECTION 23 7223

PACKAGED AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged air-to-air plate heat exchanger energy recovery units.

1.02 RELATED SECTIONS

A. Products and Execution defined in this Section shall be commissioned. Refer to Sections 23 08 00 and 01 91 13 for scope of work and responsibilities related to commissioning.

1.03 REFERENCE STANDARDS

A. AHRI 1060 I-P - Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2011.

B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2012.

C. ASHRAE Std 84 - Method of Testing Air to Air Heat/Energy Exchangers; 2013.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2012.

H. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; 2006

I. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals for submittal procedures.

B. Product Data: Manufacturer's installation instruction, product data, and engineering calculations.

C. Shop Drawings: Show design and assembly of energy recovery unit and installation and connection details.

D. Seismic restraint shop drawings and calculations for attachment of unit to curb and curb to roof, developed under direct supervision of a Professional Structural Engineer exerienced with the design of this Work.
   1. Design Engineer Qualifications: Licensed in the State in which the Project is located. (State of Oregon)
   2. Conform to design calculations for attachment for seismic restraint as required for acquiring permits.
   3. Provide calculatons and shop drawings. Submit to the City of Salem as a deferred submittal.
   4. Provide building permit for roof curbs.

E. Closeout Submittals: Submit manufacturer's operation and maintenance instructions.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 7000 - Contract Closeout for additional provisions.

2. Spare Parts: One spare set of filters for balancing, and one additional set for final turnover to Owner.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Firm regularly engaged in manufacturing energy recovery units..
   2. Products in satisfactory use in similar service for not less than five years.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in manufacturer's unopened packaging.

B. Store products to be installed indoors in dry, heated area.

1.07 WARRANTY

A. See Section 01 7000 - Contract Closeout, for additional warranty requirements

B. Warranty ventilator to be free from defects in material and workmanship and of all parts for period of 10 years for the ERV core and 2 years for the balance of the unit from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Energy Recovery Ventilators:
   1. RenewAire:www.renewaire.com. as scheduled.
   2. Substitutions: See Section 01 6000 - Material and Equipment.

2.02 ENERGY RECOVERY UNITS

A. Energy Recovery Units: Static fixed plate type crossflow construction, heat and humidity transfer; prefabricated packaged system designed by manufacturer.
   1. Access: Hinged and/or screwed access panels on front.
   2. Lifting holes at the unit base.
   3. Framing: Welded extruded aluminum tubular frame capable of supporting components and casings.
   4. Permanent name plate listing manufacturer mounted inside door near electrical panel.

2.03 CASING

A. Wall, Floor, and Roof Panels:
   1. Exterior Wall: G90 galavanized, 20 gauge steel with lapped corners and zinc plated screw fasteners..
   2. Insulation:
      a. 1 inch, 4 lb. density, foil/scrim faced high density fiberglass board insulation. Minimum R-value: 4.3..
      b. Flame Spread Index: 25, maximum, when tested in accordance with ASTM E84, NFPA 255, and UL 723.
      c. Smoke Developed Index: 50, maximum, when tested in accordance with ASTM E84, NFPA 255, and UL 723.
   3. Roof Panel: Sloped and weatherproof.
   4. Panel Joints: T-shaped standing seams with overlapping metal caps.
   5. Seams: Sealed, requiring no caulking at job site.

B. Access Panels: Provide access to components through a large, tightly sealed and easily removable panel.

C. Doors:
   1. Construct doors of same construction and thickness as wall panels.
   2. Hardware:
      a. Hinges: Aluminum.
      b. Corrosion-resistant.
      c. Provide exterior handle and interior 3-point latching device.

d. Prop Rod: Capable of propping doors in open position.
e. Wind Restraint: Door chain with spring to absorb force of door swinging open.
f. Gasket: P-shaped extruded neoprene.
g. Label each door to identify equipment located within.

D. Duct Connection Collars: 0.08 inches aluminum, continuously welded.

E. Weather Hood: Provide on fresh air inlet and exhaust air outlet; removable for access.
1. Construction: ASTM A653/A653M G90/Z275 galvanized, 20 gage, 0.0359 inch steel sheet.
2. Screening: Expanded aluminum bird screen.
3. Fresh Air Weather Hood: Maintain a face velocity less than 500 feet/min.

2.04 FANS

A. Provide separate fans for exhaust and supply blowers.

B. Fans:
1. Individually driven with a dedicated motor.
2. Backward inclined.
3. Single width, single inlet.
4. Provide with non-overloading characteristics.

C. Bearings:
1. Pillow block.
2. Bearings: Permanently lubricated sealed ball bearings.
3. Rated for not less than 200,000 hours of operation with accessible greased fittings.

D. Motors:
1. Motors: Open drip proof.
2. Efficiency: Premium.
3. Control: Variable Frequency Drive.
4. Motor Slide Bases: Removable and adjustable.
5. Fan Motor: Thermal overload protected.
6. Fan Motor: UL listed and labeled.

E. Drives:
1. Fans: Belt driven.

2.05 AIR-TO-AIR PLATE HEAT EXCHANGER

A. Comply with UL Standards.

B. Energy recovery cores used shall be third party certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacturer's published performance for airflow, static pressure, temperature and total effectivenes, pruge air (OACF) and exhaust air leakage (EATR). Products not currently AHRI Certified will not be accepted.

C. Energy Transfer: ERV core capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.

D. Passive Frost Control: ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside air above -10 deg. F. and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

E. Positive Airstream Separation: Water vapor transfer shall be through molecular transport by hydroscopic resin and shall not be accomplished by "porous plate" mechanisms. Exhaust and fresh airstreams shall travel at all times in separate passages, and airstreams shall not mix.

F. Laminar Flow: Airflow through the ERV core shall be laminar over the product's entire operating airflow range, avoiding deposition of particulates on the interior of the energy exchange plate material.

2.06 FILTERS

A. Efficiency: 8 MERV.

B. Exhaust and Fresh Air Streams: MERV 8 filters constructed to meet ASHRAE Std 52.2.

C. Filter Removal Hooks: Provide means to remove filters that are not immediately accessible from exterior of unit

D. Provide spare set of filters.

2.07 DAMPERS

A. Provide factory installed isolation dampers for both airstreams. The insulated dampers shall be of low leakage design and shall not restrict the airstream, reducing airflow, in any way. The dampers shall be opened with a motor actuator powered by the standard unit tranformer package and have a spring return for low off-position powere consumtion.

2.08 ROOF CURBS

A. Curbs: Provide full perimeter roof curb fabricated from 10 gage, 0.1345 inch aluminized steel.
   1. Curbs: Knock-down type.
   2. Provide flat for roof deck.
   3. 24" high

B. Curb to be provided by manufacuter using a third party vendor (Thybar Thycurb or equivalent) to meet specific unit requirements.

C. Gaskets: Provide closed cell PVC foam.
   1. Install between top flange of isolation rail and bottom of energy recovery unit.
   2. Install on top of curb.

2.09 POWER AND CONTROLS

A. Motor Control Panels: UL listed.

B. Include necessary motor starters, fuses, transformers and overload protection according to NFPA 70.

C. Provide single-point field connection to power supply and a single point 24 VAC contactor control connection. Internal power wiring to supply fan and exhaust fan VFDs shall be factory installed by the ERV manufacturer.

D. Unit electrical box shall include a factory installed, non-fused disconnect switch and a 24 VAC, Class II transformer / relay package.

E. Install wiring in accordance with NFPA 70.

2.10 ACCESSORIES

A. The ERV shall be provided "inverter ready" to be controlled by unit mounted VFDs.

B. Provide factory installed Variable Frequency Drives (VFDs) allowing either preset or variable speed operation with appropriate 0-10 volt DC or DDC control signal.

C. Mount VFDs in a dedicated NEMA 3R compartment located on the primary access side of its associated fan section and wire VFD to motor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that structure is ready for installation of unit, that openings in deck for ductwork, if required, are correctly sized and located, and that mechanical and electrical utilities supplying unit are of correct capacities and are accessible.

3.02 INSTALLATION

A. Provide openings for suitable ductwork connection.

B. Outdoor Installations:
   1. Roof Panels:
      a. Fasteners: Use concealed means of attachment.
      b. Minimize penetrations through roof.
      c. Provide weather tight seal at required penetrations.
   2. Provide drip edge around roof perimeter.
   3. Do not locate roof panel joints above doors.
   4. Install ERV on a roof curb as scheduled and indicated on drawings.

3.03 SYSTEM STARTUP

A. Provide services of manufacturer's authorized representative to provide start up of unit.

3.04 CLEANING

A. Clean filters, air plenums, interior and exposed-to-view surfaces prior to Substantial Completion.

END OF SECTION

SECTION 23 8129

VARIABLE REFRIGERANT FLOW (VRF) HVAC SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Variable refrigerant flow HVAC system includes:
   1. Outdoor/Condensing unit(s).
   2. Indoor/Evaporator units.
   3. Heat Recovery/Branch selector units.
   4. Control panels.
   5. Control wiring.

1.02 RELATED REQUIREMENTS

A. Section 01 7900 - Demonstration and Training.

B. Section 01 9113 - General Commissioning Requirements.

C. Section 22 1005 - Plumbing Piping: Condensate drain piping.

D. Section 23 0800 - Commissioning of HVAC.

E. Section 23 2300 - Refrigerant Piping and Specialties: Additional requirements for refrigerant piping system.

F. Section 26 2717 - Equipment Wiring: Power connections to equipment.
   1. Provide separate power connections for each unit of equipment.

1.03 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.

B. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.

C. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc; 2013, Including All Addenda (ANSI/ASHRAE/IES Std 90.1).

D. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Literature: Catalog Data for all equipment, controls and accessories.

C. Shop Drawings: Complete layout of equipment, piping, and controls, including sizing and system performance in both heating and cooling design conditions.

D. Design Data:
   1. Provide design calculations showing that system will achieve performance specified.
   2. Provide design data required by ASHRAE 90.1.

E. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings shown in the contract documents:
   1. Outdoor/Central Units:
      a. Refrigerant Type and Size of Charge.
      b. Cooling Capacity: Btu/h.

c. Heating Capacity: Btu/h.
d. Cooling Input Power: Btu/h.
e. Heating Input Power: Btu/h.
f. Operating Temperature Range, Cooling and Heating.
g. Sound Pressure Level: dB(A).
h. Electrical Data:
1) Maximum Circuit Amps (MCA).
2) Maximum Fuse Amps (MFA).
3) Maximum Starting Current (MSC).
4) Full Load Amps (FLA).
5) Total Over Current Amps (TOCA).
6) Fan Motor: HP.
i. Weight and Dimensions.
j. Maximum number of indoor units that can be served.
k. Maximum refrigerant piping run from outdoor/condenser unit to indoor/evaporator unit.
l. Maximum height difference between outdoor/condenser unit to indoor/evaporator unit, both above and below.
m. Control Options.

2. Indoor/Evaporator Units:
a. Cooling Capacity: Btu/h.
b. Heating Capacity: Btu/h.
c. Cooling Input Power: Btu/h.
d. Heating Input Power: Btu/h.
e. Air Flow: Cubic feet per minute.
f. Fan Curves.
g. External Static Pressure (ESP): Inches WG.
h. Sound Pressure level: dB(A).
i. Electrical Data:
1) Maximum Circuit Amps (MCA).
2) Maximum Fuse Amps (MFA).
3) Maximum Starting Current (MSC).
4) Full Load Amps (FLA).
5) Total Over Current Amps (TOCA).
6) Fan Motor: HP.
j. Maximum Lift of Built-in Condensate Pump.
k. Weight and Dimensions.
l. Control Options.

3. Control Panels: Complete description of options, control points, zones/groups.

F. Specimen Warranty: Copy of manufacturer's warranties.

G. Shop Drawings: Installation drawings custom-made for this project; include as-designed HVAC layouts, locations of equipment items, refrigerant piping sizes and locations, condensate piping sizes and locations, remote sensing devices, control components, electrical connections, control wiring connections. Include:
1. Detailed piping diagrams, with branch balancing devices.
2. Condensate piping routing, size, and pump connections.
3. Detailed power wiring diagrams.
4. Detailed control wiring diagrams.
5. Locations of required access through fixed construction.
6. Drawings required by manufacturer.

H. Operating and Maintenance Data:
1. Manufacturer's complete standard instructions for each unit of equipment and control panel.

2. Custom-prepared system operation, troubleshooting, and maintenance instructions and recommendations.
3. Identification of replaceable parts and local source of supply.

I. Project Record Documents: Record the following:
1. As-installed routing of refrigerant piping and condensate piping.
2. Locations of access panels.
3. Locations of control panels.

J. Warranty: Executed warranty, made out in Owner's name.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least 5 years.
2. Company that provides system design software to installers.

B. Installer Qualifications: Trained and approved by manufacturer of equipment.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

1.08 WARRANTY

A. See Section 01 7000 - Contract Closeout, for additional warranty requirements.

B. Compressors: Provide manufacturer's parts and labor warranty for six (6) years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced at the discretion of the manufacturer according to the manufacturer's terms and conditions. All warranty service work shall be preformed by a manufacturer factory trained service professional.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: The system design shown in the contract documents is based on equipment and system designed by LG Electronics USA; Inc. www.lg.com/us.

B. Substitutions: See Section 01 6000 - Material and Equipment.

2.02 HVAC SYSTEM DESIGN

A. System Operation: Heating and cooling, simultaneously.
1. Zoning: Provide capability for temperature control for each individual indoor/evaporator unit independently of all other units.
2. Zoning: Provide heating/cooling selection for each individual indoor/evaporator unit independently of all other units.
3. Provide a complete functional system that achieves the specified performance based on the specified design conditions and that is designed and constructed according to the equipment manufacturer's requirements.
4. Conditioned spaces are shown on the drawings.
5. Outdoor/Condenser unit locations are shown on the drawings.
6. Indoor/Evaporator unit locations are shown on the drawings.
7. Heat Recovery / Branch selector unit locations are shown on the drawings.
8. Required equipment unit capacities are shown on the drawings.
9. Refrigerant piping sizes are indicated on the piping schematic diagrams.
10. Connect equipment to existing condensate piping; condensate piping is not shown on the drawings.

B. Operating Temperature Ranges:
1. Cooling Mode Operating Range: 23 degrees F to 122 degrees F dry bulb.

2. Heating Mode Operating Range: 0 degrees F to 77 degrees F dry bulb; minus 4 degrees F to 60 degrees F wet bulb; without low ambient controls or auxiliary heat source.

C. Controls: Provide the following control interfaces:
1. For Each Indoor/Evaporator Unit: One wall-mounted wired "local" controller, with temperature sensor; locate where indicated.
2. One central remote control panel for entire system; locate where directed.

D. Local Controllers: Wall-mounted, wired, containing temperature sensor.

2.03 EQUIPMENT

A. All Units: Factory assembled, wired, and piped and factory tested for function and safety.
1. Refrigerant: R-410A.
2. Performance Certification: AHRI Certified; www.ahrinet.org.
3. Safety Certification: Tested to UL 1995 by UL or Intertek-ETL and bearing the certification label.
4. Provide outdoor/condensing units capable of serving indoor unit capacity up to 200 percent of the capacity of the outdoor/condensing unit.
5. Provide units capable of serving the zones indicated.
6. Thermal Performance: Provide heating and cooling capacity as indicated, based on the following nominal operating conditions:
7. Energy Efficiency: Report EER and COP based on tests conducted at “full load” in accordance with AHRI 210/240 or alternate test method approved by U.S. Department of Energy.

B. Electrical Characteristics:
1. Power - Condensing Units: 460 Volts, 3-phase, 60 Hz.
2. Power - Heat Recovery/Branch Selector Units: 208 to 230 Volts, single phase, 60 Hz.
3. Power - Indoor Units: 208 to 230 Volts, single phase, 60 Hz.
4. 208-230 Voltage Range: 187 to 253 volts.

C. System Controls:
1. Include self diagnostic, auto-check functions to detect malfunctions and display the type and location.

D. Remote On/Off Control Panel: BACnet Gateway (Application Specific Controller)

E. Wiring:
1. Control Wiring: 18 AWG, 2-conductor, non-shielded, non-polarized, stranded cable.
2. Control Wiring Configuration: Daisy chain.

F. Refrigerant Piping:
1. Provide three-pipe refrigerant system, including high/low pressure dedicated hot gas, liquid and suction lines; two-pipe systems utilizing lower temperature mixed liquid/gas refrigerant to perform heat recovery are not permitted due to reduced heating capabilities.
2. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance; T-style joints are prohibited.
3. Insulate each refrigerant line individually between the condensing and indoor units.

2.04 OUTDOOR/CONDENSING UNITS

A. Outdoor/Condensing Units: Air-cooled DX refrigeration units, designed specifically for use with indoor/evaporator units; factory assembled and wired with all necessary electronic and refrigerant controls; modular design for ganging multiple units.
1. Refrigeration Circuit: Scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.
2. Refrigerant: Factory charged.

3. Variable Volume Control: Modulate compressor capacity automatically to maintain constant suction and condensing pressures while varying refrigerant volume to suit heating/cooling loads.
4. Capable of being installed with wiring and piping to the left, right, rear or bottom.
5. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle (cooling mode) oil return or defrost is not permitted, due to potential reduction in space temperature.
6. Sound Pressure Level: As specified, measured at 3 feet from front of unit; provide night setback sound control as a standard feature; three selectable sound level steps of 55 dB, 50 dB, and 45 dB, maximum.
7. Power Failure Mode: Automatically restart operation after power failure without loss of programmed settings.
8. Provide refrigerant auto-charging feature and refrigerant charge check function.
9. Safety Devices: High pressure sensor and switch, low pressure sensor/switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
10. Provide refrigerant sub-cooling to ensure the liquid refrigerant does not flash when supplying to us indoor units.
11. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.
12. Product: As scheduled on drawings.

B. Unit Cabinet: Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
   1. Designed to allow side-by-side installation with minimum spacing.

C. Fans: One or more direct-drive propeller type, vertical discharge, with multiple speed operation via DC (digitally commutating) inverter.
   1. Provide minimum of 2 fans for each condensing unit.
   2. External Static Pressure: Factory set at 0.12 in WG, minimum.
   3. Fan Airflow: As indicated for specific equipment.
   4. Fan Motors: Factory installed; permanently lubricated bearings; inherent protection; fan guard; output as indicated for specific equipment.

D. Condenser Coils: Copper tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance.
   1. Corrosion Protection: Fins coated with anti-corrosion acrylic resin and hydrophilic film type E1; pipe plates coated with powdered polyester powder coating of 2.0 to 3.0 microns thickness.

E. Compressors: Scroll type, hermetically sealed, variable speed inverter-driven and fixed speed in combination to suit total capacity; minimum of one variable speed, inverter driven compressor per condenser unit; minimum of two compressors per condenser unit; capable of controlling capacity within range of 6 percent to 100 percent of total capacity.
   1. Variable Speed Control: Capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure; high/low pressures calculated by samplings of evaporator and condenser temperatures every 20 seconds, with compressor capacity adjusted to eliminate deviation from target value by changing inverter frequency or on/off setting of fixed speed compressors.
   2. Multiple Condenser Modules: Balance total operation hours of compressors by means of duty cycling function, providing for sequential starting of each module at each start/stop cycle, completion of oil return, and completion of defrost, or every 8 hours.
   3. Failure Mode: In the event of compressor failure, operate remaining compressor(s) at proportionally reduced capacity; provide microprocessor and associated controls specifically designed to address this condition.

4. Inverter Driven Compressors: PVM inverter driven, highly efficient reluctance DC (digitally commutating), hermetically sealed scroll “G2-type” with maximum speed of 7,980 rpm.
5. Provide each compressor with crankcase heater, high pressure safety switch, and internal thermal overload protector.
6. Provide oil separators and intelligent oil management system.
7. Provide spring mounted vibration isolators.

2.05 BRANCH SELECTOR UNITS

A. Branch Selector Units: Concealed boxes designed specifically for this type of system to control heating/cooling mode selection of downstream units; consisting of electronic expansion valves, subcooling heat exchanger, refrigerant control piping and electronics to facilitate communications between unit and main processor and between branch unit and indoor/evaporator units.
   1. Control direction of refrigerant flow using electronic expansion valves; use of solenoid valves for changeover and pressure equalization is not permitted due to refrigerant noise; use of multi-port branch selector boxes is not permitted unless spare ports are provided for redundancy.
   2. Provide one electronic expansion valve for each downstream unit served, except multiple indoor/evaporator units may be connected, provided balancing joints are used in downstream piping and total capacity is within capacity range of the branch selector.
   3. When branch unit is simultaneously heating and cooling, energize subcooling heat exchanger.
   4. Casing: Galvanized steel sheet; with flame and heat resistant foamed polyethylene sound and thermal insulation.
   5. Refrigerant Connections: Braze type.
   6. Condensate Drainage: Provide unit that does not require condensate drainage.
   7. Products: As indicated on drawings.

2.06 INDOOR/EVAPORATOR UNITS

A. All Indoor/Evaporator Units: Factory assembled and tested DX fan-coil units, with electronic proportional expansion valve, control circuit board, factory wiring and piping, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
   1. Refrigerant: Refrigerant circuits factory-charged with dehydrated air, for field charging.
   2. Temperature Control Mechanism: Return air thermistor and computerized Proportional-Integral-Derivative (PID) control of superheat.
   3. Coils: Direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.
      a. Provide thermistor on liquid and gas lines.
   4. Fans: Direct-drive, with statically and dynamically balanced impellers; high and low speeds unless otherwise indicated; motor thermally protected.
   5. Return Air Filter: Third party factory supplied, field installed, external filter housing to accept 2" disposable type filter media. Provide required sheet metal transition to connection at unit. Refer to Section 23 4000.
   6. Condensate Drainage: Built-in condensate drain pan with PVC drain connection.
      a. Units With Built-In Condensate Pumps: Provide condensate safety shutoff and alarm.
   7. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.

B. Concealed-In-Ceiling Units: Ducted horizontal discharge and return; galvanized steel cabinet.
   1. Sound Pressure: Measured at low speed at 5 feet below unit.
   2. Product(s): As scheduled on drawings.

2.07 CONTROLS

A. Central Controller – AC Smart Premium (PQCSW421E0A)
   1. General
      a. Shall be manufactured by <LG>.
      b. Shall have a minimum 10.2” backlit WSVGA TFT LCD touch screen.

c. Shall have a time clock with 12/24 hour format and calendar.
d. Shall have 10/100 BASE-T Ethernet connection.
e. Shall have web access with user level access control.
f. Shall be powered by 24 VAC (field provided)
g. Shall be capable of controlling a minimum of 128 devices without need for expansion device.
h. (viii) Shall be compatible with another of the same controller for master/slave control of all units on the communications bus.
i. Shall have micro USB port for software updates, configuration backups, saving logged data, and uploading graphics.
j. Shall have minimum two digital inputs and two digital outputs for remote system shutdown and device monitoring/control and interlocking.
k. Shall have operation and error history log.

2. Basic Functions
   a. Shall control AC unit or ventilator On/Off.
   b. Shall control Mode .
      1) Auto/Cool/Dry/Heat/Fan Only for AC unit.
      2) Recovery/Bypass/Auto for ventilator unit.
   c. Shall control AC unit discharge vanes - Auto/Swing/Fixed.
   d. Shall have remote controller lock function - All/Setpoint/Mode/Fan Speed.
   e. Error code display during unit or system malfunction.
3. Advanced Functions
   a. 200 programmable schedule events with control of setpoint, On/Off, Mode, Fan Speed, Controller Lock, and Louver Swing.
   b. Shall have two setpoint autochangeover function.
   c. Shall have two setpoint setback function.
   d. Shall have Temperature Setpoint Range Limit.
   e. Shall have AC unit run time limit (unoccupied override).
   f. Shall have software device interlocking for linking control of multiple devices.
   g. Shall have manual control and scheduling of Digital Output Kit.
   h. (viii) Shall have AC unit Peak Control function to limit energy usage.
   i. Shall have Visual Floorplan Navigation.
   j. Shall have unit and system error e-mail notification.
   k. Shall be capable of displaying and e-mailing energy usage information from Power Distribution Indicator (PDI) unit (optional).

B. Simple controller with mode selection.
1. LG Model PQRCVCL0Q(W)
   a. Unit Operation: On/Off
   b. Mode Selection: Cool/Heat/Dry/Fan/Auto
   c. Fan Speed Selection
   d. Temperature Selection
   e. LED Indicator

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that required electrical services have been installed and are in the proper locations prior to starting installation.

B. Notify Architect if conditions for installation are unsatisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install refrigerant piping in accordance with equipment manufacturer's instructions.

C. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).

D. Coordinate with installers of systems and equipment connecting to this system.

3.03 FIELD QUALITY CONTROL

A. Provide manufacturer's field representative to inspect installation prior to startup.

3.04 SYSTEM STARTUP

A. Provide manufacturer's field representative to observe and approve system startup.

B. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.

C. Adjust equipment for proper operation within manufacturer's published tolerances.

3.05 CLEANING

A. Clean exposed components of dirt, finger marks, and other disfigurements.

3.06 COMMISSIONING

A. See Section 01 9113 for commissioning requirements.

B. Perform commissioning as specified in Section 23 0800.

C. Replace components not functioning properly.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7000 - Contract Closeout, for closeout submittals

B. See Section 01 7900 - Demonstration and Training, for additional requirements.

C. Demonstrate proper operation of equipment to Owner's designated representative.

D. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Conduct walking tour of project.
   3. Briefly describe function, operation, and maintenance of each component.

E. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Manufacturer's training personnel.
   4. Location: At project site.

3.08 PROTECTION

A. Protect installed components from subsequent construction operations.

B. Replace exposed components broken or otherwise damaged beyond repair.

3.09 MAINTENANCE

A. See Section 01 7000 - Contract Closeout, for additional requirements relating to maintenance service.

END OF SECTION

SECTION 26 0501
MINOR ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

1.02 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Sustainable Design Documentation: Submit certification of removal and appropriate disposal of abandoned cables containing lead stabilizers.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Architect before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.

1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
2. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

B. Remove abandoned wiring to source of supply.

C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

E. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

F. Repair adjacent construction and finishes damaged during demolition and extension work.

G. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

H. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or that are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

END OF SECTION

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.

B. Wiring connectors.

C. Electrical tape.

D. Oxide inhibiting compound.

E. Wire pulling lubricant.

1.02 RELATED REQUIREMENTS

A. Section 26 0501 - Minor Electrical Demolition: Disconnection, removal, and/or extension of existing electrical conductors and cables.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2011).

B. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy Wire for Subsequent Covering of Insulation; 2007 (Reapproved 2012).

C. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.

D. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

F. NECA 104 - Recommended Practice for Installing Aluminum Building Wire and Cable; National Electrical Contractors Association; 2012 (NECA/AA 104).

G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).

H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Project Record Documents: Record actual locations of components and circuits.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the authority having jusrisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Underground feeder and branch-circuit cable is not permitted.

D. Service entrance cable is not permitted.

E. Armored cable is not permitted.
   1. In addition to other applicable restrictions, may not be used:
      a. Unless approved by Owner.
      b. Where not approved for use by the authority having jurisdiction.
      c. Where exposed to view.
      d. Where exposed to damage.
      e. For damp, wet, or corrosive locations.

F. Metal-clad cable is not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide new conductors and cables manufactured not more than one year prior to installation.

D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

E. Comply with NEMA WC 70.

F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

H. Conductors for Grounding and Bonding: Also comply with Section 26 0526.

I. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.

J. Conductor Material:
   1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.

a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:
1) Feeders: Copper conductors size 1/0 AWG and larger.
b. Where aluminum conductors are substituted for copper, comply with the following:
1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
3) Provide aluminum equipment grounding conductor sized according to NFPA 70.
4) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.
4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

K. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
3. Color Code:
a. 480Y/277 V, 3 Phase, 4 Wire System:
1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.
4) Neutral/Grounded: Gray.
b. 208Y/120 V, 3 Phase, 4 Wire System:
1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Neutral/Grounded: White.
c. Equipment Ground, All Systems: Green.
d. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
e. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
1. Copper Building Wire:
a. Cerro Wire LLC: www.cerrowire.com.
b. Encore Wire Corporation: www.encorewire.com.
c. Southwire Company: www.southwire.com.
d. Substitutions: See Section 01 6000 - Material and Equipment.
2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
a. Alcan Products Corporation/Alcan Cable: www.cable.alcan.com.
b. Encore Wire Corporation: www.encorewire.com.
c. Southwire Company: www.southwire.com.
d. Substitutions: See Section 01 6000 - Material and Equipment.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

1. Feeders and Branch Circuits:
    a. Size 10 AWG and Smaller: Solid.
    b. Size 8 AWG and Larger: Stranded.
2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
    a. Size 4 AWG and Larger: Type XHHW-2.
    b. Installed Underground: Type XHHW-2.
    c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.
2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

2.04 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 0526.

C. Compression Connectors: Provide circumferential type or hex type crimp configuration.

D. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.05 WIRING ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
    a. 3M: www.3m.com.
    b. Plymouth Rubber Europa: www.plymouthrubber.com.
    c. Substitutions: See Section 01 6000 - Material and Equipment.
2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
    a. Substitutions: See Section 01 6000 - Material and Equipment.
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
1. Manufacturers:
    a. Burndy: www.burndy.com.
    b. Ideal Industries, Inc: www.idealindustries.com.

c. Ilsco: www.ilsco.com.

C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
   1. Manufacturers:
      a. 3M: www.3m.com.
      b. American Polywater Corporation: www.polywater.com.
      c. Ideal Industries, Inc: www.idealindustries.com.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as shown on the drawings.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   2. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is not permitted.
   3. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.

D. Install aluminum conductors in accordance with NECA 104.

E. Installation in Raceway:
   1. Pull all conductors and cables together into raceway at same time.
   2. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   3. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
   1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
   2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

H. Install conductors with a minimum of 8 inches of slack at each outlet.

I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

J. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
   6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

K. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
   1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
      b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
   2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
      b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
   3. Wet Locations: Use heat shrink tubing.

L. Insulate ends of spare conductors using vinyl insulating electrical tape.

M. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

N. Identify conductors and cables in accordance with Section 26 0553.

O. Electrical contractor is responsible for providing firestopping system for all electrical penetrations through all fire-rated walls. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

P. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Grounding and bonding components.

C. Ground rod electrodes.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

B. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; National Electrical Manufacturers Association; 2007.

C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).

D. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
   1. Provide products listed, classified, and labeled as suitable for the purpose intended.
   2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in addition to requirements of Section 26 0519:
   1. Use insulated copper conductors unless otherwise indicated.
   2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gauge of specified conductors.

C. Connectors for Grounding and Bonding:
   1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
   2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.

3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Rod Electrodes:
   1. Comply with NEMA GR 1.
   2. Material: Copper-bonded (copper-clad) steel.
   3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.

END OF SECTION

SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

A. Section 26 0534 - Conduit: Additional support and attachment requirements for conduits.

B. Section 26 0537 - Boxes: Additional support and attachment requirements for boxes.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements - Hangers, Supports, Anchors, and Fasteners: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

B. Supports: Fabricated of structural steel or formed steel members; galvanized.

C. Anchors and Fasteners:
   1. Obtain permission from Owner before using powder-actuated anchors.
   2. Wood Elements: Use wood screws.

D. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Bolted type unless otherwise indicated.
   3. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
      b. Erico International Corporation: www.erico.com.

c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
d. Thomas & Betts Corporation: www.tnb.com.

E. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
4. Manufacturers:
a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
b. Erico International Corporation: www.erico.com.
c. PHP Systems/Design: www.phpsd.com.
d. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
e. Substitutions: See Section 01 6000 - Material and Equipment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

E. Unless specifically indicated or approved by Architect/Architect, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by Architect/Architect, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

H. Equipment Support and Attachment:
1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Conduit Support and Attachment: Also comply with Section 26 0534.

J. Box Support and Attachment: Also comply with Section 26 0537.

K. Secure fasteners according to manufacturer's recommended torque settings.

L. Remove temporary supports.

M. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
   1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
   2. Obtain permission from Owner before drilling, welding, or cutting structural members.

N. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

O. Install surface-mounted variable frequency drive cabinets with minimum of four anchors.

P. In wet and damp locations use steel channel supports to stand variable frequency drive cabinets 1 inch off wall.

Q. Use sheet metal channel to bridge studs above and below variable frequency drive cabinets recessed in hollow partitions.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 26 0534

CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Flexible metal conduit (FMC).

C. Liquidtight flexible metal conduit (LFMC).

D. Electrical metallic tubing (EMT).

E. Rigid polyvinyl chloride (PVC) conduit.

F. Conduit fittings.

G. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0537 - Boxes.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.

B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.

C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC); 2005.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); National Electrical Contractors Association; 2006.

F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); National Electrical Contractors Association; 2003.

G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2012 (ANSI/NEMA FB 1).

H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; National Electrical Manufacturers Association; 2013.

I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association; 2013.

J. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

L. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

M. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.

N. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

O. UL 651 - Schedule 40 and 80 Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

P. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

Q. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
   3. Maximum Length: 6 feet unless otherwise indicated.
   4. Vibrating equipment includes, but is not limited to:
      a. Transformers.
      b. Motors.

2.02 CONDUIT REQUIREMENTS

A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.

B. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 1/2 inch (16 mm) trade size.
   2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
   3. Control Circuits: 1/2 inch (16 mm) trade size.

E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com.
   2. Beck Manufacturing, Inc: www.beckmfg.com.
   3. Triangle PWC
   4. Western Tube and Conduit
   5. Wheatland Tube Company: www.wheatland.com.
   6. Substitutions: See Section 01 6000 - Material and Equipment.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
   1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Material: Use steel or malleable iron.
   3. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com.
   2. Anamet (type DE-710).
   3. Electri-Flex Company: www.electriflex.com.
   4. International Metal Hose: www.metalhose.com.
   5. Triangle PWC (type 710).
   6. Substitutions: See Section 01 6000 - Material and Equipment.

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
      c. Thomas & Betts Corporation: www.tnb.com.
      d. Substitutions: See Section 01 6000 - Material and Equipment.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com.
   2. Alflex
   3. Anamet (type "UA")
   4. Electri-Flex Company: www.electriflex.com.
   5. International Metal Hose: www.metalhose.com.
   6. Thomas & Betts Corporation: www.tnb.com.

7. Substitutions: See Section 01 6000 - Material and Equipment.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
      c. Thomas & Betts Corporation: www.tnb.com.
      d. Substitutions: See Section 01 6000 - Material and Equipment.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.

2.06 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com.
   2. Beck Manufacturing, Inc: www.beckmfg.com
   3. Triangle PWC.
   4. Wheatland Tube Company: www.wheatland.com.
   5. Substitutions: See Section 01 6000 - Material and Equipment.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com.
      b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
      c. Thomas & Betts Corporation: www.tnb.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.
   4. Connectors and Couplings: Use compression (gland) or set-screw type.
      a. Do not use indenter type connectors and couplings.
   5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.

2.07 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
   1. Cantex Inc: www.cantexinc.com.
   2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com.
   3. JM Eagle: www.jmeagle.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify routing and termination locations of conduit prior to rough-in.

E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

E. Conduit Routing:
   1. Unless dimensioned, conduit routing indicated is diagrammatic.
   2. When conduit destination is indicated and routing is not shown, determine exact routing required.
   3. Conceal all conduits unless specifically indicated to be exposed.
   4. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
   5. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
   6. Route conduits above water and drain piping where possible.
   7. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
   8. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
   9. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
      a. Heaters.
      b. Hot water piping.
      c. Flues.
   10. Group parallel conduits in the same area together on a common rack.

F. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.

G. Connections and Terminations:
   1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
   2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
   3. Use suitable adapters where required to transition from one type of conduit to another.
   4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
   5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.

6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

H. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Provide suitable modular seal where conduits penetrate exterior wall below grade.
5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
7. Provide metal escutcheon plates for conduit penetrations exposed to public view.

I. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.

J. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

K. Provide grounding and bonding in accordance with Section 26 0526.

3.03 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.04 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26 0537

BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Floor boxes.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0534 - Conduit:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association; 2010.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2012 (ANSI/NEMA FB 1).

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2008 (Revised 2010) (ANSI/NEMA OS 1).

E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; National Electrical Manufacturers Association; 2008 (Revised 2010) (ANSI/NEMA OS 2).

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.

G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.

C. Samples:
1. Floor Boxes: Provide one sample(s) of each floor box proposed for substitution upon request.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Material and Equipment, for additional provisions.
2. Keys for Lockable Enclosures: Two of each different key.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.

2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Use suitable concrete type boxes where flush-mounted in concrete.
4. Use suitable masonry type boxes where flush-mounted in masonry walls.
5. Use raised covers suitable for the type of wall construction and device configuration where required.
6. Use shallow boxes where required by the type of wall construction.
7. Do not use "through-wall" boxes designed for access from both sides of wall.
8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
12. Minimum Box Size, Unless Otherwise Indicated:
    a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
    b. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
13. Manufacturers:
    a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com.
    b. Hubbell Incorporated; Bell Products: www.hubbell-bell.com.
    c. Hubbell Incorporated; RACO Products: www.hubbell-raco.com.
    d. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
    e. Thomas & Betts Corporation: www.tnb.com.
    f. Substitutions: See Section 01 6000 - Material and Equipment.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA 250 Environment Type, Unless Otherwise Indicated:
    a. Indoor Clean, Dry Locations: Type 1, painted steel.
    b. Outdoor Locations: Type 4X, fiberglass, non-metallic.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    b. Back Panels: Painted steel, removable.
    c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
6. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
    b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com.
    c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com.
    d. Stahlin Non-Metallic Enclosures: Robroy Industries: www.robroy.com.
    e. Substitutions: See Section 01 6000 - Material and Equipment.

D. Floor Boxes:

1. Description: Floor boxes compatible with floor box service fittings provided; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Use cast iron floor boxes within slab on grade.
3. Use sheet-steel or cast iron floor boxes within slab above grade.
4. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
5. Manufacturer: Same as manufacturer of floor box service fittings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

F. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

G. Box Locations:
   1. Locate boxes to be accessible. Provide access panels as required where approved by the Architect.
   2. Unless dimensioned, box locations indicated are approximate.
   3. Locate boxes as required for devices installed under other sections or by others.
   4. Locate boxes so that wall plates do not span different building finishes.
   5. Locate boxes so that wall plates do not cross masonry joints.
   6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
   7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
   8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
   9. Fire-Resistance-Rated Walls: Install flush-mounted boxes such that the required fire-resistance will not be reduced.
      a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
      b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
   10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0534.
   11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
      a. Concealed above accessible suspended ceilings.

b. Within joists in areas with no ceiling.
c. Electrical rooms.
d. Mechanical equipment rooms.
e. Rooftop.

H. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
3. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

I. Install boxes plumb and level.

J. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

K. Install boxes as required to preserve insulation integrity.

L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

M. Electrical contractor is responsible for providing firestopping system for all electrical penetrations through all fire-rated walls. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

N. Close unused box openings.

O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

P. Provide grounding and bonding in accordance with Section 26 0526.

Q. Identify boxes in accordance with Section 26 0553.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 0553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Warning signs and labels.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.03 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.

C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2012.

E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:

1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Submittals for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    a. Enclosed switches, circuit breakers, and variable frequency motor controllers:
        1) Identify voltage and phase.
        2) Identify power source and circuit number. Include location when not within sight of equipment.
        3) Identify load(s) served. Include location when not within sight of equipment.
    b. Enclosed Contactors:
        1) Identify ampere rating.
        2) Identify voltage and phase.
        3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
        4) Identify coil voltage.
        5) Identify load(s) and associated circuits controlled. Include location.
2. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
3. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
4. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
5. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
6. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
7. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
8. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for new electrical equipment installed under this project.
    a. Minimum Size: 3.5 by 5 inches.
    b. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data:
        1) Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
        2) Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
        3) Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
        4) Include the following information:
            (a) Arc flash protection boundary.
            (b) Incident energy.
            (c) Hazard/risk category.
            (d) PPE (personnel protective equipment) requirements.
            (e) Nominal voltage.
            (f) Shock hazard condition.
            (g) Limited approach boundary.
            (h) Restricted approach boundary.
            (i) Prohibited approach boundary.
            (j) Equipment identification.
            (k) Date calculations were performed.
9. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.

10. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
11. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.

C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
   a. At each source and load connection.
   b. Within boxes when more than one circuit is present.
   c. Within equipment enclosures when conductors and cables enter or leave the enclosure.

D. Identification for Raceways:
1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
   a. Color-Coded Bands: Use vinyl color coding electrical tape to mark bands 3 inches wide.
      1) Vinyl Color Coding Electrical Tape: Comply with Section 26 0519.
3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
4. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
5. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.

E. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
2. Use voltage markers or color coded boxes to identify systems other than normal power system.
3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
   a. For exposed boxes in public areas, use only identification labels.
4. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

F. Identification for Devices:
1. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
   a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
2. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
3. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

G. Identification for Luminaires:
   1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
   1. Manufacturers:
      a. Brimar Industries, Inc: www.brimar.com.
      b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
      c. Seton Identification Products: www.seton.com.
      d. Substitutions: See Section 01 6000 - Material and Equipment.
   2. Materials:
      a. Indoor Clean, Dry Locations: Use plastic nameplates.
      b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
   3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
      a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
   4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
   5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
   6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
   1. Manufacturers:
      a. Brady Corporation: www.bradyid.com.
      b. Brother International Corporation: www.brother-usa.com.
      c. Panduit Corp: www.panduit.com.
   2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
   3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
   1. Minimum Size: 1 inch by 2.5 inches.
   2. Legend:
      a. System designation where applicable:
         1) Low Voltage System: Identify CAUTION: High Voltage.
      b. Equipment designation or other approved description.
      c. Other information as indicated.
   3. Text: All capitalized unless otherwise indicated.
   4. Minimum Text Height:
      a. System Designation: 1 inch.
      b. Equipment Designation: 1/2 inch.
      c. Other Information: 1/4 inch.
      d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
   5. Color:
      a. Normal Power System: White text on black background.

D. Format for General Information and Operating Instructions:
   1. Minimum Size: 1 inch by 2.5 inches.

2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.

E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch.
5. Color: Black text on yellow background unless otherwise indicated.

F. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Power source and circuit number or other designation indicated.
a. Include voltage and phase for other than 120 V, single phase circuits.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

G. Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

2.03 WIRE AND CABLE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradyid.com.
2. HellermannTyton: www.hellermanntyton.com.
3. Panduit Corp: www.panduit.com.
4. Substitutions: See Section 01 6000 - Material and Equipment.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
1. Do not use handwritten text.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradyid.com.
2. Brimar Industries, Inc: www.brimar.com.
3. Seton Identification Products: www.seton.com.
4. Substitutions: See Section 01 6000 - Material and Equipment.

B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

D. Minimum Size:
   1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
   2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
   3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
   4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

E. Legend:
   1. Markers for Voltage Identification: Highest voltage present.
   2. Markers for System Identification:
      a. Other Systems: Type of service.

F. Color: Black text on orange background unless otherwise indicated.

2.05 WARNING SIGNS AND LABELS

A. Manufacturers:
   1. Brimar Industries, Inc: www.brimar.com.
   2. Clarion Safety Systems, LLC: www.clarionsafety.com.
   3. Seton Identification Products: www.seton.com.
   4. Substitutions: See Section 01 6000 - Material and Equipment.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:
   1. Materials:
      a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
      b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
   2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
   3. Minimum Size: 7 by 10 inches unless otherwise indicated.

D. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Conduits: Legible from the floor.
   8. Boxes: Outside face of cover.
   9. Conductors and Cables: Legible from the point of access.

10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
   1. Do not use adhesives on exterior surfaces except where substrate can not be penetrated.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Secure rigid signs using stainless steel screws.

G. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 26 2200
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

C. Section 26 0534 - Conduit: Flexible conduit connections.

D. Section 26 2416 - Panelboards.

1.02 REFERENCE STANDARDS

A. IEEE C57.94 - Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers; 1982 (R2006).

B. IEEE C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers; 1999 (R2004).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

D. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2009.

E. NEMA ST 20 - Dry-Type Transformers for General Applications; National Electrical Manufacturers Association; 1992 (R1997).

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2008

G. NEMA TP 1 - Guide for Determining Energy Efficiency for Distribution Transformers; 2002.

H. NEMA TP 2 - Standard Test Method for Measuring the Energy Consumption of Distribution Transformers; 2005.

I. NEMA TP 3 - Standard for the Labeling of Distribution Transformer Efficiency; 2000.

J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).

K. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.

M. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors required for mounting of transformers.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Maintenance Data: Include recommended maintenance procedures and intervals.

F. Project Record Documents: Record actual locations of transformers.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.07 FIELD CONDITIONS

A. Ambient Temperature: Do not exceed 86 degrees F average or 104 degrees F maximum measured during any 24 hour period during and after installation of transformers.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Siemens Industry, Inc: www.usa.siemens.com.

B. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.

C. General Electric Company: www.geindustrial.com.

D. Schneider Electric; Square D Products: www.schneider-electric.us.

E. Substitutions: See Section 01 6000 - Material and Equipment.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
   1. Altitude: Less than 3,300 feet.
   2. Ambient Temperature: Not exceeding 86 degrees F average or 104 degrees F maximum measured during any 24 hour period.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B. Primary Voltage: 480 volts delta, 3 phase.

C. Secondary Voltage: 208Y/120 volts, 3 phase.

D. Insulation System and Allowable Average Winding Temperature Rise:
   1. Less than 15 kVA: Class 185 degrees C insulation system with 115 degrees C average winding temperature rise.
   2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

E. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.

F. Winding Taps:
   1. Less than 3 kVA: None.
   2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
   3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
   4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.

G. Energy Efficiency: Standard efficiency complying with NEMA TP 1.
   1. Test efficiency according to NEMA TP 2.
   2. Label transformer according to NEMA TP 3.

H. Sound Levels: Standard sound levels complying with NEMA ST 20.
   1. 51-150 kVA: 70 dB.

I. Mounting Provisions:
   1. Less than 15 kVA: Suitable for wall mounting.
   2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
   3. Larger than 75 kVA: Suitable for floor mounting.

J. Transformer Enclosure: Comply with NEMA ST 20.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor clean, dry locations: Type 2.
   2. Construction: Steel.
      a. Less than 15 kVA: Totally enclosed, non-ventilated.
      b. 15 kVA and Larger: Ventilated.
   3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
   4. Provide lifting eyes or brackets.

K. Accessories:
   1. Mounting Brackets: Provide manufacturer's standard brackets.
   2. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

2.04 SOURCE QUALITY CONTROL

A. Factory test transformers according to NEMA ST 20.

B. Sound Level Tests: Perform factory test designated in NEMA ST 20 as "design" test on each production unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.

C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1.

B. Install transformers in accordance with manufacturer's instructions.

C. Install transformers in accordance with NECA 409 and IEEE C57.94.

D. Use flexible conduit, under the provisions of Section 26 0534, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

F. Mount floor-mounted transformers using vibration isolators suitable for isolating the transformer noise from the building structure.

G. Provide seismic restraints.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

J. Where not factory-installed, install lugs sized as required for termination of conductors as shown on the drawings.

K. Where furnished as a separate accessory, install transformer weathershield per manufacturer's instructions.

L. Identify transformers in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection, testing, and adjusting in accordance with Section 01 4000.

B. Inspect and test in accordance with NETA ATS, except Section 4.

3.04 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from transformer components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2416

PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Lighting and appliance panelboards.

B. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 2200 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; National Electrical Contractors Association; 2009.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2008.

E. NEMA PB 1 - Panelboards; National Electrical Manufacturers Association; 2011.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; National Electrical Manufacturers Association; 2013 (ANSI/NEMA PB 1.1).

G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).

H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 67 - Panelboards; Current Edition, Including All Revisions.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.

4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
2. Include wiring diagrams showing all factory and field connections.
3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
4. Include documentation of listed series ratings upon request.

D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:

1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Siemens Industry, Inc: www.usa.siemens.com.

B. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.

C. General Electric Company: www.geindustrial.com.

D. Schneider Electric; Square D Products: www.schneider-electric.us.

E. Substitutions: See Section 01 6000 - Material and Equipment.

F. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study to be performed by Contractor.
   2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
   3. Label equipment utilizing series ratings as required by NFPA 70.

D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
      b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
      c. Provide removable end walls for NEMA Type 1 enclosures.
      d. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.

c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.

4. Lockable Doors: All locks keyed alike unless otherwise indicated.

I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

J. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

K. Provide the following features and accessories where indicated or where required to complete installation:

1. Feed-through lugs.

2.03 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:

1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.

C. Bussing:

1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Aluminum.
3. Ground Bus Material: Aluminum.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:

1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
   a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
   b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
3. Conductor Terminations:
   a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

2.05 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 0529.

E. Install panelboards plumb.

F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

H. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

I. Provide grounding and bonding in accordance with Section 26 0526.
   1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.

J. Install all field-installed branch devices, components, and accessories.

K. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

L. Set field-adjustable circuit breaker tripping function settings as indicated.

M. Provide filler plates to cover unused spaces in panelboards.

N. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:

3.03 FIELD QUALITY CONTROL

A. Perform inspection, testing, and adjusting in accordance with Section 01 4000.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 20 amperes. Tests listed as optional are not required.
   1. Perform insulation-resistance tests on all control wiring with respect to ground.
   2. Test functions of the trip unit by means of secondary injection.

D. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2717
EQUIPMENT WIRING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

B. Electrical connections to motors furnished under Div 23.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).

B. Section 26 0534 - Conduit.

C. Section 26 0537 - Boxes.

D. Section 26 2818 - Enclosed Switches.

1.03 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2010).

B. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002 (R2008).

C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Conform to NEMA WD 1.
   2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
   3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 26 28 18 and in individual equipment sections.

C. Flexible Conduit: As specified in Section 26 0534.

D. Wire and Cable: As specified in Section 26 0519.

E. Boxes: As specified in Section 26 0537.

2.02 EQUIPMENT CONNECTIONS

A. Equipment connection shall be according to NEC:
   1. Electrical Connection: Flexible conduit.
   2. Electrical Connection: Cord and plug (NEMA 6-20R).
   3. Provide field-installed disconnect switch as required by NEC or drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 26 2818
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

A. Section 26 0529 - Hangers and Supports for Electrical Systems.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

C. Section 26 2913 - Enclosed Controllers: Manual motor controllers.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2008.

C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2013.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).

E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Siemens Industry, Inc: www.usa.siemens.com.

B. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.

C. General Electric Company: www.geindustrial.com.

D. Square D: www.squared.com.

E. Substitutions: See Section 01 6000 - Material and Equipment.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Horsepower Rating: Suitable for connected load.

C. Voltage Rating: Suitable for circuit voltage.

D. Short Circuit Current Rating:
   1. Minimum Ratings:
      a. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

E. Provide with switch blade contact position that is visible when the cover is open.

F. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
   1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

I. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

K. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

L. Heavy Duty Switches:
   1. Comply with NEMA KS 1.
   2. Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install enclosed switches in accordance with manufacturer's instructions.

B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide fuses for fusible switches as indicated or as required by equipment manufacturer's recommendations.

H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

I. Identify enclosed switches in accordance with Section 26 0553.

J. Install fuses in fusible disconnect switches sized to protect the load being served.

K. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.03 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.04 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2913
ENCLOSED CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manual motor controllers.

B. Magnetic motor controllers.

C. Combination magnetic motor controllers and disconnects.

1.02 RELATED REQUIREMENTS

A. Section 26 0529 - Hangers and Supports for Electrical Systems.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

B. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC; National Electrical Manufacturers Association; 2000 (R2008).

C. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; National Electrical Manufacturers Association; 2000 (R2010).

D. NEMA ICS 6 - Industrial Control and Systems: Enclosures; National Electrical Manufacturers Association; 1993 (R2006).

E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton Corporation; Cutler-Hammer Product: www.eaton.com.

B. General Electric Company: www.geindustrial.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Siemens Industry, Inc: www.sea.siemens.com.

E. Substitutions: See Section 01 6000 - Material and Equipment.

2.02 MANUAL CONTROLLERS

A. Manual Motor Controllers: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, and toggle operator.

2.03 AUTOMATIC CONTROLLERS

A. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

B. Coil Operating Voltage: 120 volts, 60 Hertz.

C. Overload Relays: NEMA ICS 2; bimetal.

D. Enclosures: NEMA ICS 6, Type 1.

2.04 ACCESSORIES

A. Auxiliary Contacts: NEMA ICS 2, 2 normally open contacts in addition to seal-in contact.

B. Cover Mounted Pilot Devices: NEMA ICS 5, standard duty oiltight type.

C. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.

D. Pushbuttons: Unguarded type.

E. Indicating Lights: Transformer, LED type.

F. Selector Switches: Rotary type.

2.05 DISCONNECTS

A. Combination Controllers: Combine motor controllers with disconnects in common enclosure. Obtain IEC Class 2 coordinated component protection.

B. Motor Circuit Protector: Circuit breakers with integral instantaneous magnetic trip in each pole; UL listed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.

B. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

C. Provide supports in accordance with Section 26 0529.

D. Select and install overload heater elements in motor controllers to match installed motor characteristics.

E. Identify enclosed controllers in accordance with Section 26 0553.

3.02 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01 4000.

END OF SECTION

SECTION 28 3100

FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire alarm system design and installation, including all components, wiring, and conduit to shut down new fan coil units from the fire alarm control panel upon smoke detector activation.

B. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.

1.02 RELATED REQUIREMENTS

A. Section 23 3300 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

B. Section 23 8129 - Varible Refrigerant Flow (VRF) HVAC System: New fan coil units to be connected and controlled by fire alarm system.

1.03 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Evidence of designer qualifications.

C. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
   1. Copy (if any) of list of data required by authority having jurisdiction.
   2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
   3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
   4. System zone boundaries and interfaces to fire safety systems.
   5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
   6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
   7. List of all devices on each signaling line circuit, with spare capacity indicated.
   8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
   9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
   10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
   11. Certification by the manufacturer of the control unit that the system design complies with the contract documents.
   12. Certification by Contractor that the system design complies with the contract documents.
   13. Do not show existing components to be removed.

D. Evidence of installer qualifications.

E. Evidence of instructor qualifications; training lesson plan outline.

F. Evidence of maintenance contractor qualifications, if different from installer.

G. Inspection and Test Reports:
   1. Submit inspection and test plan prior to closeout demonstration.
   2. Submit documentation of satisfactory inspections and tests.
   3. Submit NFPA 72 "Inspection and Test Form," filled out.

H. Operating and Maintenance Data: See Section 01 7800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:

1. Complete set of specified design documents, as approved by authority having jurisdiction.
2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
4. List of recommended spare parts, tools, and instruments for testing.
5. Replacement parts list with current prices, and source of supply.
6. Detailed troubleshooting guide and large scale input/output matrix.
7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

I. Project Record Documents: See Section 01 7800 for additional requirements; have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
2. "As installed" wiring and schematic diagrams, with final terminal identifications.
3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

J. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with his installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.

1.04 QUALITY ASSURANCE

A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.

C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Alarm Control Units - Basis of Design: SELECT/ENTER MANUFACTURER NAME AND ENTER MODEL NUMBER.

2.02 FIRE ALARM SYSTEM

A. Fire Alarm System: Provide modifications and extensions to the existing automatic fire detection and alarm system:

1. Provide all components necessary, regardless of whether shown in the contract documents or not.
2. Protected Premises: Entire building shown on drawings.
3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
    a. ADA Standards.
    b. The requirements of the local authority having jurisdiction, which is City of Salem.
    c. Applicable local codes.
    d. The contract documents (drawings and specifications).
    e. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
4. Fire Command Center: Location indicated on drawings.
5. Master Control Unit (Panel): Existing, located at fire command center.

B. Supervising Stations and Fire Department Connections:
1. Public Fire Department Notification: Via existing system.

C. Circuits:
1. Initiating Device Circuits (IDC): Class B, Style A.
2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
3. Notification Appliance Circuits (NAC): Class B, Style W.

D. Power Sources:
1. Primary: Dedicated branch circuits of the facility power distribution system.
2. Secondary: Storage batteries.
3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
4. Each Computer System: Provide uninterruptible power supply (UPS).

2.03 EXISTING COMPONENTS

A. Clearly label components that are "Not In Service."

B. Remove unused existing components and materials from site and dispose of properly.

2.04 FIRE SAFETY SYSTEMS INTERFACES

A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:

B. HVAC:
1. Duct Smoke Detectors: Shut down air handlers.

2.05 COMPONENTS

A. General:
1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. Fire Alarm Control Units, Initiating Devices, and Notification Appliances: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Master Control Unit: As specified for Basis of Design above, or equivalent.

D. Initiating Devices:

E. Notification Appliances:

F. Circuit Conductors: Copper or optical fiber; provide 200 feet extra; color code and label.

G. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

H. Locks and Keys: Deliver keys to Owner.

I. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
   1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
   2. Provide one for each control unit where operations are to be performed.
   3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
   4. Provide extra copy with operation and maintenance data submittal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and the contract documents.

B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.

C. Obtain Owner's approval of locations of devices, before installation.

D. Install instruction cards and labels.

3.02 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.03 OWNER PERSONNEL INSTRUCTION

A. Provide the following instruction to designated Owner personnel:
   1. Hands-On Instruction: On-site, using operational system.
   2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.

B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
   1. Initial Training: 1 session pre-closeout.

C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
   1. Initial Training: 1 session pre-closeout.

D. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

3.04 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
   1. Be prepared to conduct any of the required tests.
   2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of control unit manufacturer present during demonstration.
   4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.

5. Repeat demonstration until successful.

3.05 MAINTENANCE

A. See Section 01 7000 - Execution Requirements, for additional requirements relating to maintenance service.

B. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
   1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
   2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
   3. Record keeping required by NFPA 72 and authorities having jurisdiction.

C. Provide trouble call-back service upon notification by Owner:
   1. Provide on-site response within 2 hours of notification.
   2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
   3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

D. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

E. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.

F. Comply with Owner's requirements for access to facility and security.

END OF SECTION

SECTION 31 2316

EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating for slabs-on-grade.

1.02 RELATED REQUIREMENTS

A. Section 31 2323 - Fill: Fill materials, filling, and compacting.

1.03 PROJECT CONDITIONS

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

B. Protect plants, lawns and other features to remain.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the work are as indicated.

2.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities that remain and protect from damage.

2.03 EXCAVATING

A. Underpin adjacent structures that could be damaged by excavating work.

B. Excavate to accommodate new structures and construction operations.

C. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

D. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

E. Do not interfere with 45 degree bearing splay of foundations.

F. Cut utility trenches wide enough to allow inspection of installed utilities.

G. Hand trim excavations. Remove loose matter.

H. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 2323.

I. Grade top perimeter of excavation to prevent surface water from draining into excavation.

J. Remove excavated material that is unsuitable for re-use from site.

K. Stockpile excavated material to be re-used in area designated on site .

L. Remove excess excavated material from site.

M. Hand dig in areas where utilities may be located.

2.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.

B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

2.05 PROTECTION

A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION

SECTION 31 2323

FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Filling, backfilling, and compacting for slabs-on-grade.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 31 2316 - Excavation: Removal and handling of soil to be re-used.

1.03 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010

B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.

C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.

D. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

E. Oregon Department of Transportation.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Samples: 10 lb sample of each type of fill; submit in air-tight containers to testing laboratory.

C. Materials Sources: Submit name of imported materials source.

D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

E. Compaction Density Test Reports.

1.05 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where indicated.
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. Granular Fill - Fill Type A: 3/4" minus crushed rock.

2.02 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.

B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.

C. If tests indicate materials do not meet specified requirements, change material and retest.

D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Identify required lines, levels, contours, and datum locations.

B. Verify structural ability of unsupported walls to support imposed loads by the fill.

3.02 PREPARATION

A. Scarify subgrade surface to a depth of 6 inches to identify soft spots.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

A. Fill to contours and elevations indicated using unfrozen materials.

B. Fill up to subgrade elevations unless otherwise indicated.

C. Employ a placement method that does not disturb or damage other work.

D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.

G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.

H. Correct areas that are over-excavated.
   1. Load-bearing foundation surfaces: Use structural fill, flush to required elevation, compacted to 90 percent of maximum dry density.
   2. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.

I. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under slabs-on-grade: 90 percent of maximum dry density.

J. Reshape and re-compact fills subjected to vehicular traffic.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.

B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor"), ASTM D1557 ("modified Proctor"), or AASHTO T 180.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest.

3.05 CLEANING

A. Leave unused materials in a neat, compact stockpile.

B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 32 3113
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fence framework, fabric, and accessories.

B. Excavation for post bases; concrete foundation for posts.

C. Manual gates and related hardware.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete anchorage for posts.

1.03 REFERENCE STANDARDS

A. ASTM A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire; 2013.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

D. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.

F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.

G. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2014.

H. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2011.

I. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework; 2012.

J. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2010.

1.04 SUBMITTALS

A. See Section 01 3000 - Submittals, for submittal procedures.

B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

D. Samples: Submit two samples of fence fabric, slat infill, 12 inch by 12 inch in size illustrating construction and colored finish.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Chain Link Fences and Gates:
   1. Master-Halco, Inc.: www.masterhalco.com.
   2. Merchants Metals: www.merchantsmetals.com.
   3. Substitutions: See Section 01 6000 - Material and Equipment.

2.02 MATERIALS

A. Posts, Rails, and Frames: ASTM F1083 Schedule 40 hot-dipped galvanized steel pipe, welded construction, minimum yield strength of 30 ksi.

B. Barbed Wire: Zinc-coated steel, complying with ASTM A121 Type Z Coating Class 1; 2 strands of 0.099 inch diameter wire, with 4-pointed barbs at 4 inches on center. 12 1/2 gauge

C. Concrete: Type specified in Section 03 3000.

2.03 COMPONENTS

A. Line Posts: 2 7/8 inch diameter.

B. Corner and Terminal Posts: 4.0 inch.

C. Gate Posts: 4.5 inch diameter.

D. Top and Brace Rail: 1 7/8 inch diameter, plain end, sleeve coupled.

E. Gate Frame: 1 7/8 inch diameter for welded fabrication.

F. Fabric: 2 inch diamond mesh interwoven wire, 6 gage, 0.1620 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.

G. Tension Wire: 6 gage, 0.1620 inch thick steel, single strand.

H. Tension Band: Manufacturers standard thickness.

I. Tension Strap: Manufacturer standard thickness

J. Tie Wire: 9 gage wire

2.04 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

C. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position.

D. Privacy Slats: Vinyl strips, sized to fit fabric weave.

E. Gate Keeper.

2.05 FINISHES

A. Components and Fabric: Vinyl coated over coating of 1.8 oz/sq ft galvanizing.

B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.

C. Accessories: Same finish as framing.

D. Color(s): As selected from Manufacturer's standard colors.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Line Post: Install with Floor Flange that has (2) set screws using 1/2 inch diameter anchor bolts

C. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: 3 feet.

D. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.

E. Install center brace rail on corner gate leaves.

F. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.

G. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

H. Do not attach the hinged side of gate to building wall; provide gate posts.

I. Install gate with fabric to match fence. Install hardware.

J. Install gate keeper in 12 inch diameter by 24 inch deep concrete footing

3.02 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Position: 1 inch.

C. Components shall not infringe adjacent property lines.

END OF SECTION

PHOTOS

PHOTO M1 MECHANICAL DEMOLITION

PHOTO M2 MECHANICAL DEMOLITION

PHOTO M3 MECHANICAL DEMOLITION

PHOTO M4 MECHANICAL DEMOLITION

PHOTO E1 ELECTRICAL DEMOLITION

PHOTO E2 ELECTRICAL DEMOLITION

PHOTO E3 ELECTRICAL DEMOLITION

PHOTO E4 ELECTRICAL DEMOLITION

MECHANICAL DEMOLITION - PHOTO M1

GENERAL: Remove all heat recovery piping (HRS / HRR) and associated appurtenances (valves, tanks, pumps, etc.) in Room 1107. Cap and abandon piping at floor or wall penetrations.

Glycol Feed Tank

Glycol Storage Tanks

MECHANICAL DEMOLITION - PHOTO M2

NOTE 1: REMOVE HRP-1 and HRP-2

MECHANICAL DEMOLITION - PHOTO M3

NOTE 1: EWH-1 TO REMAIN (KITCHEN)
NOTE 2: ST-1 TO REMAIN (DHW)

MECHANICAL DEMOLITION - PHOTO M4

GENERAL: Remove HWHP-1 and associated circulation pump in unit cabinet. Remove HW piping between unit and existing storage tank ST-1 (tank to remain). Coordinate point of piping demolition with associated piping appurtenances (eg. temperature sensors, control valves, pressure gauges, etc) that need to be retained as part of the DHW system as required. Remove piping associated with heat recovery system serving HWHP-1.

NOTE 1: HWHP-1 TO BE REMOVED
NOTE 2: REMOVE PIPING TO SHUT OFF VALVE
NOTE 3: HEAT RECOVERY PIPING TO BE REMOVED

ELECTRICAL DEMOLITION - PHOTO E1

GENERAL: Remove all electrical associated with the heat pump system, including conduit and wire back the electrical panel or back to the nearest ‘J’ Box, if that ‘J’ box is used for other building electrical

NOTE 1: RETAIN EXISTING OUTLET

ELECTRICAL DEMOLITION - PHOTO E2

GENERAL: Remove all electrical associated with the heat pump system, including conduit and wire back the electrical panel or back to the nearest ‘J’ Box, if that ‘J’ box is used for other building electrical.

NOTE 1: EXISTING UPS TO REMAIN - PROTECT

NOTE 2: THESE PUMPS ARE HIGHLIGHTED TO BE REMOVED

ELECTRICAL DEMOLITION - PHOTO E3

GENERAL: Remove all electrical associated with the heat pump system, including conduit and wire back the electrical panel or back to the nearest 'J' Box, if that 'J' box is used for other building electrical.

NOTE: The new 75 KVA transformer will be located in this corner. Coordinate exact location with owner

NOTE 1: HVAC CONTROLERS – REMOVE AND SALVAGE TO OWNER

NOTE 2: HVAC DISCONNECTS – REMOVE SALVAGE TO OWNER

ELECTRICAL DEMOLITION - PHOTO E4

GENERAL: Remove all electrical associated with the hot water heat pump system, including conduit and wire back the electrical panel or back to the nearest ‘J’ Box, if that ‘J’ box is used for other building electrical.

NOTE 1: HWHP TO BE DEMOLISHED