

**BEAVERTON SD**  
CEDAR MILL ELEMENTARY

PROJECT NO.: 1335.009.003  
DATE: January 14, 2019

**ELECTRICAL/MECHANICAL SPECS**

PREPARED BY:  
**R&W**  
ENGINEERING, INC.

**AIA DOCUMENT A101-2017** *STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR*

- (INCORPORATED BY REFERENCE)

**AIA DOCUMENT A201-2017** *GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION*

- (INCORPORATED BY REFERENCE)

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END OF SECTION



**PROJECT TEAM**

OWNER'S REPRESENTATIVE

Beaverton School District  
16550 SW Merlo Rd  
Beaverton, OR 97003  
Contact: Jeff Hamman, Project Manager  
Contact: Patrick O'Harrow, Project Coordinator

MECHANICAL – ELECTRICAL ENGINEER

R&W Engineering, Inc.  
9615 SW Allen Blvd, Suite 107  
Beaverton, OR 97005  
Contact: Ed Carlisle

ARCHITECT/ STRUCTURAL ENGINEER

CIDA  
15895 SW 72<sup>ND</sup> Ave, Suite 200  
Portland, OR 97224  
Contact: Dustin Johnson

HAZARDOUS MATERIAL SURVEYOR

TRC  
4105 SE International Way, Suite 505  
Milwaukie, OR 97222  
Contact: Ron Landolt

COMMISSIONING AGENT

GLUMAC  
900 SW Fifth Ave., Suite 1600  
Portland, OR 97204  
Contact: Jeremy Braithwaite

GENERAL CONTRACTOR

TBD

PART 1 – GENERAL

1.1 STATUS OF GENERAL CONDITIONS

A. Supplements:

1. Supplements in this Document modify, change, delete from and add to the general conditions listed in *Standard Form of Agreement Between Owner and Contractor AIA Document A101-2017 Edition* and *General Conditions of the Contract for Construction AIA Document A201, 2017 Edition*.
2. Where any Article, Paragraph, subparagraph or clause of the above general conditions is modified or deleted by these supplements, the unaltered provisions of that Article, Paragraph, subparagraph or clause shall remain in effect.

1.2 MODIFICATIONS TO GENERAL CONDITIONS

A. General Provisions:

1. Correlation and intent of the contract documents:
  - a. References in Contract Documents to building codes, industry standards, published specifications and manufacturer's instructions shall mean the current edition of the referenced document in effect on the date of the signed Owner-Contractor Agreement.
  - b. In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:
    1. Modifications.
    2. The Agreement.
    3. Addenda, with those of later date having precedence over those of earlier date.
    4. The Supplementary Conditions.
    6. Division 1 of the Specifications.
    7. Drawings and Divisions 2–49 of the Specifications.
    8. Other documents specifically enumerated in the Agreement as part of the Contract Documents.
  - c. In the case of conflicts or discrepancies between Drawings and Divisions 2–49 of the Specifications, or within or among the Contract Documents and not clarified by Addendum, the Architect will determine which takes precedence in accordance with the General Conditions of the Contract.
  - d. Immediately notify Architect/Engineer of any error, omission or discrepancy appearing on the Contract Documents. In the event of a conflict or discrepancy of the Contract Documents, the larger quantity and highest quality shall govern, unless the smaller quantity or lower quality is accepted by written clarification or modification is issued by the Architect/Engineer.

## 1.3 INTERPRETATION:

- A. Viewed or approved by Architect/Engineer shall mean written review or approval by Architect/Engineer or an authorized consultant.
- B. Terms used in the Specifications such as approved, accepted, directed, required, reviewed and selected shall be interpreted to mean as approved, accepted, directed, required, reviewed and selected the Architect/Engineer.
- C. Reference in the Specifications to a single item or piece of equipment shall apply to as many such items as are indicated on Drawings or required to complete the Project.
- D. Listing an item or method in the Specifications or indicating an item or method on the Drawings requires the Contractor to furnish, fabricate and install the item, unless indicated otherwise.

## 1.4 FEES

- A. Unless otherwise indicated in the Contract Documents, the Owner shall pay for plan check fees and building permit fees, including sewer, gas and water connection fees, as well as other assessments or fees established by the authority having jurisdiction. The Contractor shall pay for all other permits, fees, licenses and inspections necessary for proper execution and completion of Work, including plumbing, mechanical and electrical permit fees.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and drawing conventions.

B. Related Section:

1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Cedar Mill Elementary School – Roof, HVAC & Electrical Upgrade

1. Project Location: 10265 NW Cornell Rd, Portland, OR 97229

B. Owner: Cedar Mill Elementary School

C. Owner's Representative: Beaverton School District

1. Contact: Jeff Hamman, Project Manager (503) 356-4571
2. Contact: Patrick O'Harrow, Project Coordinator (503) 356-4584

D. Owner's Commissioning Agent: GLUMAC

1. Contact: Jeremy Braithwaite (503) 227-5280

E. Owner's Hazardous Material Surveyor: TRC

1. Contact: Ron Landolt (503) 387-3251

F. Mechanical, Electrical and Plumbing Engineer: R&W Engineering, Inc.

1. Contact: Ed Carlisle (503) 726-3322

G. Architect and Structural Engineer: CIDA

1. Contact: Dustin Johnson, RA (503) 226-1285 X 327
2. Contact: Sam Corbin, SE (503) 226-1285 X 328

H. General Contractor: TBD

1. Contact: TBD

### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following:
  - 1. General upgrade of the building mechanical systems including associated electrical work, structural support and architectural patch and repair work required to accommodate mechanical upgrades and new roof overlay.
- B. Type of Contract.
  - 1. Project will be constructed under a single prime contract.
    - a. *Standard Form of Agreement Between Owner and Construction Manager as Constructor AIA Document A133, 2009 Edition*
    - b. *General Conditions of the Contract for Construction AIA Document A201, 2007 Edition.*

### 1.4 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

### 1.5 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
  - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
  - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
  - 3. Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

### 1.6 WORK RESTRICTIONS

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

1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.
  2. Comply with noise ordinances of the authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building and site as follows:
1. Weekdays: 6:00 a.m. to 5:00 p.m (Custodian until 6:00 p.m.).
  2. Saturdays and Sundays: Arrange with Owner's Representative
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
1. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
1. Notify Owner not less than two days in advance of proposed disruptive operations.
  2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Controlled Substances: Use of tobacco products and other controlled substances on the Project site is not permitted.

#### 1.7 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
  3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Description: Contractor shall provide within his bid amount the allowances as described in the Schedule of Allowances at the end of this Section. The allowance has been established in lieu of additional requirements for that work, and further requirements for allowances will be issued by the Architect prior to work indicated by the allowance. A change order for the work will be written to compensate for the required work identified by each allowance.
- C. Cash Allowance: A monetary sum that is to be included as part of the contract sum to account for certain items to be determined at a later time.

1.2 SELECTION AND PURCHASE

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

1.3 COORDINATION

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

1.4 ALLOWANCES

- A. The cash allowance amounts listed below are to be added to the contract price as a line item that is not included within the Contractor's total contract amount and therefore do not have overhead, profit or insurance included. These items will be included within the Change Order if needed.
- B. Except as indicated above, comply with provisions of the General Conditions.
- C. The Architect and Owner's Representative will determine work that will be applied to the Allowances listed below. The Contractor shall price and perform work as additional work to the Contract. Requested work will be changed to the Contract by Change Order written against the Contract.
- D. A Change Order will be written to credit the Allowance amounts listed below. Overhead, profit and insurance will not be included within these change order amounts.



PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALLOWANCES

A. Review possible allowances with the District

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Section:
  - 1. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

### 1.2 DEFINITIONS

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

### 1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. Schedule:
  - 1. A "Schedule of Unit Prices" is included at the end of this section.
  - 2. Include as part of each unit price, miscellaneous devices, appurtenances and similar items incidental to or required for a complete system whether or not mentioned as part of the unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 Schedule of Unit Prices:

- A. Hazardous Material Abatement (PENDING COORDINATION WITH TRC)
  - 1. Ceilings (Unit: Cost per square foot)
  - 2. Interior walls and furring walls (Unit: Cost per square foot)
  - 3. Floors (Unit: Cost per square foot)
- B. Patch & Repair Work at Hazardous Material Abatement Areas
  - 1. Ceilings (Unit: Cost per square foot)
  - 2. Interior walls (Unit: Cost per square foot)
  - 3. Floors (Unit: Cost per square foot)
- C. New Sheet Metal Fabrications at Roof Edge Conditions
  - 1. New 24ga. pre-finished drip edge cap flashing – See Detail 2/A3.2 in drawings for profile. (Unit: Cost per linear foot)
  - 2. New 24 ga. pre-finished sheet metal gutter and downspouts (Unit: Cost per lineal foot)
  - 3. New 24ga. pre-finished sheet metal coping cap (Unit: Cost per lineal foot)
- D. Roof Sheathing Replacement at Roof Overlay Areas
  - 1. Roof sheathing replacement at areas discovered during construction to be damaged or rotted. This item includes roof sheathing found to be rotted or damaged as a result of physical investigation if recommended by third party roof moisture surveyor (required by Section 075323).

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

### 1.2 DEFINITIONS

- A. Alternate: An amount proposed by the Contractor in Bid Proposal, including changes in Work as described by the alternates listed in this section. Alternates may be either additive or deductive to the Base Bid. The alternate amount will either be added to or deducted from the Base Bid amount if the Owner decides to accept a corresponding change in either scope of work or in products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
  - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

### 1.3 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate #1: Review possible bid alternates with the Owner's Representative.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

### 1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

### 1.3 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Architect to forward any substitution to BSD representative for approval prior to acceptance by the Architect.
  - 1. Substitution Request Form: Use CSI Substitution Request Form 1.5C provided at the end of this section.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. Certificates and qualification data, where applicable or requested.
    - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
    - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided

within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

- k. Cost information, including a proposal of change, if any, in the Contract Sum.
- l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
- m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

## PART 2 - PRODUCTS

### 2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 15 fifteen days prior to time required for preparation and review of related submittals.
  - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:
    - a. Requested substitution has been approved by the Owner.
    - b. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed.

## PART 3 - EXECUTION (Not Used)

END OF SECTION



# SUBSTITUTION REQUEST

(During the Bidding Phase)

Project: \_\_\_\_\_ Substitution Request Number: \_\_\_\_\_  
\_\_\_\_\_  
From: \_\_\_\_\_  
To: \_\_\_\_\_ Date: \_\_\_\_\_  
A/E Project Number: \_\_\_\_\_  
Re: \_\_\_\_\_ Contract For: \_\_\_\_\_

Specification Title: \_\_\_\_\_ Description: \_\_\_\_\_  
Section: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_  
Trade Name: \_\_\_\_\_ Model No.: \_\_\_\_\_

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Submitted by: \_\_\_\_\_  
Signed by: \_\_\_\_\_  
Firm: \_\_\_\_\_  
Address: \_\_\_\_\_  
Telephone: \_\_\_\_\_

## A/E's REVIEW AND ACTION

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

Signed by: \_\_\_\_\_

Date: \_\_\_\_\_

Supporting Data Attached: ☐ Drawings ☒ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ \_\_\_\_\_



PART 1 - GENERAL

1.1 SUMMARY

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

1.2 MINOR CHANGES IN THE WORK

- A. Architect or Consultant may issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect or Consultant will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Proposal Requests issued by Architect/Consultant are not instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time specified in Proposal Request after receipt of Proposal Request, Contractor shall submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  - 3. Proposal Request Log: Contractor shall maintain a current log of all proposed requests and submit same at each project meeting and with each application for payment. Each proposal request shall have a unique number for tracking purpose. The log shall, at a minimum, show the proposal request number, date initiated, brief description, reference (i.e. RFI or supplemental instruction), estimated cost, estimated time, status, and reason for the proposal request (i.e. Unforeseen Condition/ Regulatory Requirement/ Owner Request/ E&O).

1.4 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: Refer to Division 01 Section "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit Price Adjustment: Refer to Division 01 Section "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit price work.

1.5 CHANGE ORDER PROCEDURES

- A. On District's approval of a Proposal Request, Architect/Consultant will issue a Change Order for signatures of Owner and Contractor on form provided by the District.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Upon request of the Owner's Representative Architect/Consultant may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
  - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  - 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Distribute signed application including copy of waivers of lien and similar attachments to e-Builder.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
  - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  - 2. When an application shows completion of an item, submit conditional final or full waivers.
  - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  - 4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

PAYMENT PROCEDURES  
SECTION 012900

- G. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- H. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706-1994, "Contractor's Affidavit of Payment of Debts and Claims."
  5. AIA Document G706A-1994, "Contractor's Affidavit of Release of Liens."
  6. AIA Document G707-1994, "Consent of Surety to Final Payment."
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Coordination drawings.
  - 2. Requests for Information (RFIs).
  - 3. Project Web site.
  - 4. Project meetings.

1.2 DEFINITIONS

- A. RFI: Request from Owner, Architect, Consultant or Contractor seeking information from each other during construction.

1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's construction schedule.
  - 2. Preparation of the schedule of values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.

6. Preinstallation conferences.
7. Project Closeout Conference.
8. Startup and adjustment of systems.
9. Project closeout activities.

#### 1.4 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - b. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing and electrical Work.
  2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings.
  3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire alarm, and electrical equipment.
  4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
  5. Review: Architect/Consultant will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility.

#### 1.5 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect/Consultant will return RFIs submitted to Architect/Consultant by other entities controlled by Contractor with no response.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

PROJECT MANAGEMENT AND COORDINATION  
SECTION 013100

- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Project number.
  3. Date.
  4. Name of Contractor.
  5. Name of Architect.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to the District.
- D. Architect's Action: Architect/Consultant will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect/Consultant after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for coordination information already indicated in the Contract Documents.
    - d. Requests for adjustments in the Contract Time or the Contract Sum.
    - e. Requests for interpretation of Architect's actions on submittals.
    - f. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's/Consultant's action may include a request for additional information, in which case the allotted time for response will date from time of receipt of additional information.
  3. Architect's/Consultant's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect/Consultant and Owner's Representative in writing within seven days of receipt of the RFI response.
- E. On receipt of Architect's/Consultant's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect/Consultant and Owner's Representative within seven days if Contractor disagrees with response.

- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of Project Web site (e-Builder).

#### 1.6 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
  - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner's Representative and Architect/Consultant of scheduled meeting dates and times.
  - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner's Representative and Architect/Consultant, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
  - 1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Procedures for processing field decisions and Change Orders.
    - f. Procedures for RFIs.
    - g. Procedures for testing and inspecting.
    - h. Procedures for processing Applications for Payment.
    - i. Distribution of the Contract Documents.
    - j. Submittal procedures.
    - k. Sustainable design requirements.
    - l. Preparation of record documents.
    - m. Use of the premises and existing building.
    - n. Work restrictions.
    - o. Working hours.
    - p. Owner's occupancy requirements.
    - q. Responsibility for temporary facilities and controls.
    - r. Procedures for moisture and mold control.
    - s. Procedures for disruptions and shutdowns.
    - t. Construction waste management and recycling.
    - u. Parking availability.



PROJECT MANAGEMENT AND COORDINATION  
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- v. Office, work, and storage areas.
    - w. Equipment deliveries and priorities.
    - x. First aid.
    - y. Security.
    - z. Progress cleaning.
  - 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect/ Consultant and Owner's Representative of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility problems.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written recommendations.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.
    - s. Regulations of authorities having jurisdiction.
    - t. Testing and inspecting requirements.
    - u. Installation procedures.
    - v. Coordination with other work.
    - w. Required performance results.
    - x. Protection of adjacent work.
    - y. Protection of construction and personnel.
  - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

PROJECT MANAGEMENT AND COORDINATION  
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5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at intervals indicated in Owner/Contractor Agreement.
1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect/ Consultant, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.
      - 5) Off-site fabrication.
      - 6) Access.
      - 7) Site utilization.
      - 8) Temporary facilities and controls.
      - 9) Progress cleaning.
      - 10) Quality and work standards.
      - 11) Status of correction of deficient items.
      - 12) Field observations.
      - 13) Status of RFIs.
      - 14) Status of proposal requests.
      - 15) Pending changes.
      - 16) Status of Change Orders.
      - 17) Pending claims and disputes.
      - 18) Documentation of information for payment requests.
  3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

PROJECT MANAGEMENT AND COORDINATION  
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- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- E. Project Closeout Conference: Conduct conference prior to Substantial Completion.
- 1. Attendees: Owner, Architect/ Consultant, Contractor.
  - 2. Agenda: Procedures for completing and archiving closeout deliverables in e-Builder;
    - a. Requirements for preparing Record Documents;
    - b. Requirements for preparing O&Ms;
    - c. Submittal of warranties;
    - d. Requirements for delivery of Maintenance stock;
    - e. Requirements for demonstration and training.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PART 1 - GENERAL

1.1 1.1 SECTION INCLUDES

- A. Summary.
- B. General Requirements
- C. System Requirements.
- D. System Access.
- E. System Use.

1.2 SUMMARY

- A. Project Management Communications: The Owner, Contractor and Architect shall use the Internet web based project Management communications tool, E-Builder ASP software and protocols included in that software during this project. The use of project management communications as herein described does not replace or change any contractual responsibilities of the participants.
- B. Purpose: The intent of using e-Builder is to improve project work efforts by promoting timely initial communications and responses and to reduce the number of paper documents while providing improved record keeping by creation of electronic document files.

1.3 General Requirements:

- A. Project management communications is available through e-Builder as provided by “e-Builder” in the form and manner required by the Owner.
- B. The project communications database is on-line and fully functional. User registration, electronic and computer equipment,, and internet connections are the responsibility of each project participant. The sharing of user accounts is prohibited.
- C. Support: e-Builder will provide on-going support through on-line help files and with website’s training documents uploaded to the project folder.
- D. Authorized Users: Access to the web site will be by individuals who are licensed users as required by the Owner.
- E. Licenses Granted by Owner’s Representative: Owner shall pay for and provide licenses/access for the following members of the project team.
  - 1. Lead member of Architect’s/Consultant’s design team responsible.
  - 2. Contractor’s project manager or lead member of Contractor’s project staff.
  - 3. Others as deemed appropriate by Owner’s Representative.

1.4 SYSTEM REQUIREMENTS:

- A. System Configuration:
  - 1. PC system 500 MHz Intel Pentium III or equivalent AMD processor.
  - 2. 128 MB Ram.
  - 3. Display capable of SVGA (1024 x 768 pixels) 256 colors display.
  - 4. 101 key keyboard.
  - 5. Mouse or other pointing device.
- B. Operating System and software configuration:
  - 1. All software shall be properly licensed with vendors or developers. Use of “e-Builder” does not convey any rights or licensure for use of any software, hardware or internet service provider.
  - 2. Software Configuration:
    - a. Most current version of Microsoft Internet Explorer (current version is a free distribution for download). This specification is not intended to restrict the host server or client computers provided that industry standard HTTP clients ay access the published content.
    - b. Most current version of Adobe Acrobat Reader (Current version is a free distribution for download).
    - c. Other plug-ins specified by e-Builder as applicable to the system (current versions are a free distribution for download from [www.e-builder.net](http://www.e-builder.net)).
    - d. Users are recommended to have a properly licensed version of the standard Microsoft Office Suite (current version must be purchased) or the equivalent.

1.5 SYSTEM ACCESS

- A. Minimum Equipment and Internet Connection: In addition to other requirements specified in this Section, the Contractor shall be responsible for providing suitable computer systems for each licensed user at the user’s normal work location with high-speed Internet access, i.e. DSL, local cable company’s Internet connection, or T1 connection.
- B. Authorized users will be contacted directly by the web site provider, e-Builder, who will assign the temporary user password.
- C. Individuals shall be responsible for the proper use of their passwords and access to data as agents of the company in which they are employed.

1.6 SYSTEM USE

- A. Owner’s Administrative Users: Owner administrative users have access and control of user licenses and all posted items. DO NOT POST PRIVATE OR YOUR COMPANY’S CONFIDENTIAL ITEMS IN THE DATABASE!
- B. Improper or abusive language toward any party or repeated posting of items intended to deceive or disrupt the work of the project will not be tolerated and will result in deletion of the offensive items and revocation of user license at the sole discretion of the Administrative User(s). Costs incurred or associated with such issues shall be the financial responsibility of the party responsible for the transgression.

- C. Communications: Communication for this project for the items listed below shall be solely through e-Builder:
1. RFI, Requests for Information.
  2. Change Order Requests.
  3. Architect's Supplemental Instructions.
  4. All other communication shall be conducted in an industry standard manner.
  5. Submittals, contracts, meeting minutes, and other project records.
  6. Application for payments.
  7. Project closeout.
- D. Document Integrity and Revisions:
1. Documents, comments, drawings and other records posted to the system shall remain for the project record. The authorship time and date shall be recorded for each document submitted to the system. Submitting a new document or record with a unique ID, authorship, and time stamp shall be the method used to make modifications or corrections.
  2. The system shall identify revised or superseded documents and their predecessors.
  3. Server or Client side software enhancements during the life of the project shall not alter or restrict the content of data published by the system. System upgrades shall not affect access to older documents or software.
- E. Document security: The system shall provide a method for communications of documents. Documents shall allow security group assignment to respect the contractual parties communication except for Administrative Users.
- F. Document Integration: Documents of various types shall be logically related to one another and discoverable,.
- G. Notifications and Distribution: Document distribution to project members shall be accomplished both within the extranet system and via email as appropriate. Project document distribution to parties outside of the project communication system shall be accomplished by secure email of outgoing documents and attachments readable by a standard email client.
- H. Ownership of Documents and Information: All documents, files or other information posted on the system shall become the property of the Owner.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

PART 1 - GENERAL

1.1 CONSTRUCTION PROGRESS DOCUMENTATION

- A. Progress Schedules and Reports: The Contractor, within ten calendar days after being awarded the Contract, shall prepare and submit for the information of the Owner's Representative and the Architect/Consultant a Progress Schedule in critical path management ("CPM") format satisfactory to the Owner's Representative for the Work. The Progress Schedule shall conform to any requirements of the Specifications, shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, shall provide for expeditious and practicable execution of the Work and shall be utilized and conformed to by the Contractor and its Subcontractors. Contractor shall comply with the Progress Schedule. The Progress schedule is for the District's benefit, and to the full extent permitted by law, changes to or variations from the Progress Schedule shall not entitle the Contractor to an extension of the Contract Time or increase of Contract Sum.
- B. Meeting Minutes: Contractor shall be responsible for the preparation and distribution of meeting minutes.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

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

### 1.2 QUALITY CONTROL

- A. Submit 3-week work schedule, shop drawings, product data, samples, schedule of values and record documents as follows:
  - 1. Submit to Architect/Consultant and Owner's Representative only through General Contractor.
  - 2. The General Contractor shall provide a set of submittals to the Owner's Representative for review and approval concurrent with review by the Architect and Consultant(s).

### 1.3 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's/ Consultant's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
  - 1. Architect/Consultant will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
    - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    - b. Digital data files are provided for Contractor's convenience and to help expedite the submittal preparation process. Use of the digital data files is at Contractor's risk and does not release the Contractor from verifying and indicating as-built conditions which may or may not be indicated in the digital data files.
    - c. Contractor shall execute a release of Architect's/Consultant's liability for Contractor's use of the digital data files. Release form shall be provide by Architect/Consultant.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect and Consultant reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.



SUBMITTAL PROCEDURES  
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- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect/Consultant's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect/Consultant or Owner's Representative will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
  2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect/Consultant.
  3. Include the following information for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Construction Manager.
    - e. Name of Contractor.
    - f. Name of subcontractor.
    - g. Name of supplier.
    - h. Name of manufacturer.
    - i. Submittal number or other unique identifier, including revision identifier.
      - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
    - j. Number and title of appropriate Specification Section.
    - k. Drawing number and detail references, as appropriate.
    - l. Location(s) where product is to be installed, as appropriate.
    - m. Other necessary identification.
- E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
  2. Name file with submittal number or other unique identifier, including revision identifier.
    - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01).

SUBMITTAL PROCEDURES  
SECTION 013300

Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect/ Consultant.
  4. Include the following information on an inserted cover sheet:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name of Construction Manager.
    - e. Name of Contractor.
    - f. Name of firm or entity that prepared submittal.
    - g. Name of subcontractor.
    - h. Name of supplier.
    - i. Name of manufacturer.
    - j. Number and title of appropriate Specification Section.
    - k. Drawing number and detail references, as appropriate.
    - l. Location(s) where product is to be installed, as appropriate.
    - m. Related physical samples submitted directly.
    - n. Other necessary identification.
- F. Options: Identify options requiring selection by the Architect.
- G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Architect's/ Consultant's action stamp.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- I. Use for Construction: Use only final submittals that are marked with approval notation from Architect's or Consultant's action stamp.

## PART 2 - PRODUCTS

### 2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

1. Post electronic submittals as PDF electronic files directly to e-Builder.
  - a. Architect/Consultant will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

SUBMITTAL PROCEDURES  
SECTION 013300

2. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures." All closeout submittals to be uploaded to e-Builder in format acceptable to the District.
  3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    - a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
    - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
  4. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams showing factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  5. Submit Product Data before or concurrent with Samples.
  6. Submit Product Data in the following format:
    - a. PDF electronic file.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data without field-verifying as-built conditions which may or may not be indicated at part of the released digital data files.

SUBMITTAL PROCEDURES  
SECTION 013300

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  2. Submit Shop Drawings in the following format:
    - a. PDF electronic file.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
  3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect/ Consultant will return submittal with options selected.
  5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or

SUBMITTAL PROCEDURES  
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containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

- a. Number of Samples: Submit three sets of Samples. Architect/Consultant will retain two Sample sets; remainder will be returned.
  - 1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
  - 1. Submit product schedule in the following format:
    - a. PDF electronic file.
- F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design.
  - 1. Submit subcontract list in the following format:
    - a. PDF electronic file.
- J. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.
- M. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

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- N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- R. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- T. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- W. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- X. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- Y. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect/Consultant and Owner's Representative.
- B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S/ CONSULTANT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect/ Consultant will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect or Consultant will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- C. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION

PART 1 - GENERAL

1.1 CONSTRUCTION/ MAINTENANCE BUILDING SECURITY RULES

- A. The Contractor shall enforce strict discipline and good order among the Contractor's employees, Subcontractors, and other persons carrying out the contract on District property. The District may require that the Contractor immediately remove from the project site and District property any employee or other person carrying out the contract that the District considers objectionable.
- B. District Personnel (i.e., Building Administrator, Custodian, or a building monitor etc.) must be present when a contractor is performing work within an existing school facility.
- C. Only District Personnel will deactivate the security system upon arriving and reactivate the system when they leave the facility.
  - 1. If the responsible District Personnel for a particular day changes during the day, the District Personnel shall coordinate this change in responsibility and advise the contractor's superintendent.
- D. Contractor personnel will not be furnished District security badges and/or access codes to the Building security system.
- E. The Contractor shall have a responsible party such as a superintendent, foreman, or supervisor on site during any work being performed by either their own forces or that of their subcontractors.
- F. The superintendent shall check in with the responsible District Personnel upon arrival and advise when all work is complete, contract personnel have left, and the area is secure.
- G. The Contractor's superintendent shall be responsible for security in areas where work is being performed as well as ingress and egress to that area.
- H. At the Owner's Representative's discretion, the superintendent may be issued a building key to allow access to areas where work is being performed.
- I. The superintendent shall maintain a daily log defining what areas within the building were accessed by Contractor personnel, which personnel from their firm were in the building, and which subcontracting firms were in the building,.
- J. Each of the Contractor's employees, Subcontractors' employees, and principals/owners involved at the site may, at the option of the District, be subject to a security check, at any time, through the Beaverton Police Department or other authority.
- K. Contractor shall perform or have performed criminal background checks for every employee on all active campus (i.e., children are present) projects prior to that employee's admittance to the project site. Once an employee passes the criminal background check they will receive an ID badge and a hard hat sticker which they must wear while they are on site at all times. Contractor may be fined up to \$500 for every worker working on site without the proper ID



badge and a hat sticker. The following are the convicted crimes that may appear on the background check:

- Aggravated Murder of Murder
- Assault in the First Degree
- Kidnapping in the First Degree
- Rape in the First, Second, or Third Degree
- Sodomy in the First, Second, or Third Degree
- Unlawful Sex Penetration in the First or Second Degree
- Arson in the First Degree
- Sexual Abuse in the First, Second, or Third Degree
- Contributing to the Sexual Delinquency of a Minor
- Sexual Misconduct
- Public Misconduct
- Public Indecency
- Bigamy
- Incest
- Child Neglect in the First Degree
- Endangering the Welfare of a Minor
- Using Child in Display of Sexually Explicit Conduct
- Sale or Exhibition of Visual Reproduction of Sexual Conduct by a Child
- Paying for Viewing of Sexual Conduct Involving a Child
- Encouraging Child Sex Abuse in First, Second or Third Degree
- Possession of Materials Depicting Sexual Explicit Conduct of a Child in the First or Second Degree
- Arson in the First Degree
- Robbery in the First Degree
- Treason
- Abuse of a Corpse in the First Degree
- Prostitution, Promoting Prostitution, or Compelling Prostitution
- Sadoomasochistic Abuse or Sexual Conduct in a Live Show
- Furnishing, Sending, or Displaying Obscene Materials to Minors
- Exhibiting an Obscene Performance to a Minor
- Disseminating Obscene Materials
- Publicly Displaying Nudity or Sex for Advertising Purposes
- Distribution of Controlled Substance to Minors
- Manufacture or Delivery of Controlled Substance to Minor or Student within 1000 Feet of a School
- Attempt to Commit Any of the Above-Listed Crimes

- L. Smoking and any use of tobacco products is not allowed within 50 feet of the campus property. Contractor may be fined up to \$500 for each incident of tobacco use within the area of work by the Contractor or Subcontractors.
- M. Firearms are not allowed on campus property. Law enforcement will be contacted if any contractor personnel are in possession of a firearm on site (Including firearms located in a locked vehicle).
- N. Abusive, inappropriate, and/or foul language is strictly prohibited on active campus projects. Employees who abuse this rule will be asked to leave the project site.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
  - 2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Consultant, Owner's Representative, or authorities having jurisdiction are not limited by provisions of this Section.

### 1.2 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

### 1.3 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, and telephone number of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  5. Other required items indicated in individual Specification Sections.
- C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

#### 1.4 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect/Consultant and Owner's Representative with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

## 1.5 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.

QUALITY REQUIREMENTS  
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3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect, Consultant, Owner's Representative and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect/Consultant, Owner's Representative and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

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

#### 1.6 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner's Representative will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner and as follows:
  1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
  2. Notifying Architect/Consultant and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect/Consultant and Owner's Representative with copy to Contractor and to authorities having jurisdiction.
  4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  6. Retesting and reinspecting corrected work.

#### PART 2 - PRODUCTS (Not Used)

#### PART 3 - EXECUTION

##### 3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

## PART 1 - GENERAL

### 1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

### 1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.



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

### 1.3 ABBREVIATIONS AND ACRONYMS

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

PRIVATE tbl1

AA	Aluminum Association, Inc. (The)
AAADM	American Association of Automatic Door Manufacturers
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ABAA	Air Barrier Association of America
ABMA	American Bearing Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies, Inc. (The)
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AGC	Associated General Contractors of America (The)
AHA	American Hardboard Association (Now part of CPA)
AHAM	Association of Home Appliance Manufacturers
AI	Asphalt Institute
AIA	American Institute of Architects (The)

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AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)
ALSC	American Lumber Standard Committee, Incorporated
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
AOSA	Association of Official Seed Analysts, Inc.
APA	Architectural Precast Association
APA	APA - The Engineered Wood Association
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems (See APA - The Engineered Wood Association)
API	American Petroleum Institute
ARI	Air-Conditioning & Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International (American Society of Mechanical Engineers International)
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWCI	Association of the Wall and Ceiling Industry
AWCMA	American Window Covering Manufacturers Association (Now WCMA)
AWI	Architectural Woodwork Institute

AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association)
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
BICSI	BICSI, Inc.
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
BISSC	Baking Industry Sanitation Standards Committee
BWF	Badminton World Federation (Formerly: IBF - International Badminton Federation)
CCC	Carpet Cushion Council
CDA	Copper Development Association
CEA	Canadian Electricity Association
CEA	Consumer Electronics Association
CFFA	Chemical Fabrics & Film Association, Inc.
CGA	Compressed Gas Association
CIMA	Cellulose Insulation Manufacturers Association
CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CRRC	Cool Roof Rating Council
CPA	Composite Panel Association
CPPA	Corrugated Polyethylene Pipe Association
CRI	Carpet and Rug Institute (The)
CRSI	Concrete Reinforcing Steel Institute

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CSA	Canadian Standards Association
CSA	CSA International (Formerly: IAS - International Approval Services)
CSI	Cast Stone Institute
CSI	Construction Specifications Institute (The)
CSSB	Cedar Shake & Shingle Bureau
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)
DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association (Electrostatic Discharge Association)
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA)
FIBA	Federation Internationale de Basketball (The International Basketball Federation)
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation)
FM Approvals	FM Approvals LLC
FM Global	FM Global (Formerly: FMG - FM Global)
FMRC	Factory Mutual Research (Now FM Global)
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.
FSA	Fluid Sealing Association
FSC	Forest Stewardship Council

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GA	Gypsum Association
GANA	Glass Association of North America
GRI	(Part of GSI)
GS	Green Seal
GSI	Geosynthetic Institute
HI	Hydraulic Institute
HI	Hydronics Institute
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
HPVA	Hardwood Plywood & Veneer Association
HPW	H. P. White Laboratory, Inc.
IAS	International Approval Services (Now CSA International)
IBF	International Badminton Federation (Now BWF)
ICEA	Insulated Cable Engineers Association, Inc.
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IEST	Institute of Environmental Sciences and Technology
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Alliance
ILI	Indiana Limestone Institute of America, Inc.
ISO	International Organization for Standardization Available from ANSI
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek Testing Service NA

	(Now ETL SEMCO)
ITU	International Telecommunication Union
KCMA	Kitchen Cabinet Manufacturers Association
LMA	Laminating Materials Association (Now part of CPA)
LPI	Lightning Protection Institute
MBMA	Metal Building Manufacturers Association
MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association, Inc.
MH	Material Handling (Now MHIA)
MHIA	Material Handling Industry of America
MIA	Marble Institute of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International (National Association of Corrosion Engineers International)
NADCA	National Air Duct Cleaners Association
NAGWS	National Association for Girls and Women in Sport
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCAA	National Collegiate Athletic Association (The)
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau

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NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFHS	National Federation of State High School Associations
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)
NOMMA	National Ornamental & Miscellaneous Metals Association
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)
NWWDA	National Wood Window and Door Association (Now WDMA)
OPL	Omega Point Laboratories, Inc. (Now ITS)
PCI	Precast/Prestressed Concrete Institute
PDCA	Painting & Decorating Contractors of America
PDI	Plumbing & Drainage Institute

REFERENCES  
SECTION 014200

PGI	PVC Geomembrane Institute
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America)
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute
RIS	Redwood Inspection Service
SAE	SAE International
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
SGCC	Safety Glazing Certification Council
SIA	Security Industry Association
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America



REFERENCES  
SECTION 014200

SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWI	Steel Window Institute
SWRI	Sealant, Waterproofing, & Restoration Institute
TCA	Tile Council of America, Inc. (Now TCNA)
TCNA	Tile Council of North America, Inc.
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TMS	The Masonry Society
TPI	Truss Plate Institute, Inc.
TPI	Turfgrass Producers International
TRI	Tile Roofing Institute
UL	Underwriters Laboratories Inc.
UNI	Uni-Bell PVC Pipe Association
USAV	USA Volleyball
USGBC	U.S. Green Building Council
USITT	United States Institute for Theatre Technology, Inc.
WASTEC	Waste Equipment Technology Association
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association)
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)
WIC	Woodwork Institute of California (Now WI)
WMMPA	Wood Moulding & Millwork Producers Association

WSRCA        Western States Roofing Contractors Association

WWPA        Western Wood Products Association

C.    Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

PRIVATE tbl2

IAPMO    International Association of Plumbing and Mechanical Officials

ICC        International Code Council

ICC-ES    ICC Evaluation Service, Inc.

UBC        Uniform Building Code  
(See ICC)

D.    Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl3

CE        Army Corps of Engineers

CPSC       Consumer Product Safety Commission

DOC        Department of Commerce

DOD        Department of Defense

DOE        Department of Energy

EPA        Environmental Protection Agency

FAA        Federal Aviation Administration

FCC        Federal Communications Commission

FDA        Food and Drug Administration

GSA        General Services Administration

HUD        Department of Housing and Urban Development

LBL        Lawrence Berkeley National Laboratory

NCHRP    National Cooperative Highway Research Program  
(See TRB)

NIST        National Institute of Standards and Technology

OSHA	Occupational Safety & Health Administration
PBS	Public Buildings Service (See GSA)
PHS	Office of Public Health and Science
RUS	Rural Utilities Service (See USDA)
SD	State Department
TRB	Transportation Research Board
USDA	Department of Agriculture
USPS	Postal Service

- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl4

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board
CFR	Code of Federal Regulations Available from Government Printing Office
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point
DSCC	Defense Supply Center Columbus (See FS)
FED-STD	Federal Standard (See FS)
FS	Federal Specification Available from Department of Defense Single Stock Point  Available from Defense Standardization Program  Available from General Services Administration  Available from National Institute of Building Sciences
FTMS	Federal Test Method Standard (See FS)

MIL (See MILSPEC)

MIL-STD (See MILSPEC)

MILSPEC Military Specification and Standards  
Available from Department of Defense Single Stock Point

UFAS Uniform Federal Accessibility Standards  
Available from Access Board

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl5

CBHF State of California, Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation

CCR California Code of Regulations

CPUC California Public Utilities Commission

TFS Texas Forest Service  
Forest Resource Development

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect/Consultant, Owner's Representative, testing agencies, and authorities having jurisdiction. Temporary facilities required for the project include but may not be limited to:
  - 1. Sanitary Facilities
  - 2. Telephone/Fax
  - 3. Internet
- B. Water from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

1.4 QUALITY ASSURANCE

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

1.5 PROJECT CONDITIONS

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

## PART 2 - PRODUCTS

### 2.1 TEMPORARY FACILITIES

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

### 2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures."

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
  - 1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  - 1. Provide portable facilities as required for workmen. Keep facilities clean and in sanitary condition. Remove from the site upon completion of the Work.
- C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

TEMPORARY FACILITIES AND CONTROLS  
SECTION 015000

- D. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- F. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
  - 1. Connect temporary service to Owner's existing power source, as directed by Owner.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
  - 2. At a conspicuous place within the primary field office post a list of important telephone numbers, including:
    - a. Police and fire departments.
    - b. Ambulance service.
    - c. Contractor's home office.
    - d. Architect's office.
    - e. Engineers' offices.
    - f. Owner's Representative's office.
    - g. Principal subcontractors' field and home offices.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- B. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- C. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

TEMPORARY FACILITIES AND CONTROLS  
SECTION 015000

- D. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Prohibit smoking in construction areas.
  2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  3. Develop and supervise an overall fire-prevention -and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.4 MOISTURE AND MOLD CONTROL

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

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION



PART 1 - GENERAL

1.1 MATERIAL AND EQUIPMENT SELECTION

- A. Comply with standards and these specifications including size, make, type, and quality specified, or as accepted in writing by the Architect/Consultant and Owner's Representative.
- B. All products shall be new and of current manufacture unless otherwise specified.
- C. All similar products shall be of the same manufacturer.
- D. Manufactured and Fabricated Products:
  - 1. Design, fabricate, and assemble in accordance with the best engineering and shop practices.
  - 2. Manufacture like parts of duplicate units to standard sizes and gauges and to be interchangeable.
  - 3. All similar products shall be of the same manufacturer. Two or more items of the same kind shall be considered identical and by the same manufacturer.
  - 4. Provide products suitable for service conditions.
  - 5. Adhere to equipment capacities, sizes, and dimensions shown or specified unless variations are specifically approved in writing by the Architect/Consultant or Owner's Representative.
- E. Do not use material or equipment for any purpose other than that for which it is designed or is specified.
- F. Fabricate and install equipment to deliver its full rated capacity at the efficiency for which it was designed.
- G. Select and install equipment to operate at full capacity without excessive noise or vibration.
- H. Provide electrical products with Underwriter's Laboratories Label or as approved by the local inspection authority.
- I. Any software provided with products shall be provided with appropriate licensing and use agreements for a minimum of 10 years.

1.2 MANUFACTURER'S INSTRUCTIONS

- A. Perform work in accordance with manufacturer's printed installation instructions, obtain and distribute copies of such instructions to parties involved in the installation, including submittal to the Architect through the Owner's Project Management Database (e-Builder).
- B. Maintain one set of complete instructions at the job site during installation and until completion.
- C. Handle, install, connect, clean, condition, and adjust products in strict accordance with manufacturer's printed instructions and in conformity with specified requirements.

COMMON PRODUCT REQUIREMENTS  
SECTION 016100

1. Consult with Architect/Consultant for further instructions should job conditions or specified requirements conflict with manufacturer's instructions.
  2. Do not proceed with work without clear instructions.
- D. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Coordination of Owner-installed products.
  - 5. Progress cleaning.
  - 6. Starting and adjusting.
  - 7. Protection of installed construction.
  - 8. Correction of the Work.
- B. Related Sections:
  - 1. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
  - 2. Division 01 Section "Cutting and Patching".

### 1.2 QUALITY ASSURANCE

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

### 1.3 WARRANTY

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

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
  1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
  2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner's Representative that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect/ Consultant according to requirements in Division 01 Section "Project Management and Coordination."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and as-built conditions. If discrepancies are discovered, notify Architect/ Consultant promptly.

### 3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
  - 1. Allow for building movement, including thermal expansion and contraction.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.5 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.6 STARTING AND ADJUSTING

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

- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

### 3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

### 3.8 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.

### 1.2 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

### 1.3 WARRANTY

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

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials. Submit 3 samples for Architect and Owner approval.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
  - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.



2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

### 3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
  5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

CUTTING AND PATCHING  
SECTION 017329

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

## PART 1 - GENERAL

### 1.1 SUMMARY

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

### 1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Advise Owner's Representative of pending insurance changeover requirements.
  - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
  - 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  - 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  - 8. Complete startup testing of systems.
  - 9. Submit test/adjust/balance records.
  - 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  - 11. Advise Owner of changeover in heat and other utilities.
  - 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  - 13. Complete final cleaning requirements, including touchup painting.
  - 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
  - 15. Prepare Closeout Log: An electronic spreadsheet log listing all closeout deliverables required in the specifications including contractor's record drawings, warranties, shop drawings, product data, extra stock, training and O&Ms. See Sample Closeout Log provided in at the end of this section.

- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect, Consultant and Owner's Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
  - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  - 2. Results of completed inspection will form the basis of requirements for final completion.

### 1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
  - 1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
  - 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  - 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  - 4. Submit pest-control final inspection report and warranty.
  - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect, Consultant and Owner's Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
  - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

### 1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
  - 1. Organize list of spaces in a sequential order.
  - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  - 3. Submit list of incomplete items in the following format:
    - a. PDF electronic file.

## 1.5 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
  - 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
  - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
  - 4. Scan warranties and bonds and assemble complete warranty and bond submittal package into individual PDF files organized by specification section.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
  - 1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

CLOSEOUT PROCEDURES  
SECTION 017700

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
  - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
  - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
  - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
  - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
  - e. Remove snow and ice to provide safe access to building.
  - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  - h. Sweep concrete floors broom clean in unoccupied spaces.
  - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
  - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not permanent.
  - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    - 1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
  - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
  - r. Leave Project clean and ready for occupancy.

END OF SECTION

CLOSEOUT LOG: Cedar Mill Elementary School HVAC & Roofing Project

	e-B Project number 8286		REQUIREMENTS PER SPECIFICATIONS (YES/NO)								
SPEC SECTION	SPECIFICATION DESCRIPTION	SUBCONTRACTOR	O&M	Recvd	WARRANTY	Recvd	EXTRA STOCK MATERIAL	Recvd	OWNER TRAINING	Recvd	AS-BUILT
DIVISION 03 - CONCRETE											
033000	Cast-in-place Concrete				1 year warranty						
DIVISION 06 - WOOD, PLASTICS AND COMPOSITES											
061000	Rough Carpentry				1 year warranty						
064023	Interior Architectural Woodwork		Product Data		1 year warranty						
DIVISION 07 - THERMAL AND MOISTURE											
075323	EPDM Fully- Adhered Roofing		Product Info and Care		Provide manufacturer's system guarantee as follows: 1. Single-Source special guarantee includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover board, substrate board, vapor retarder, walkway products, manufacturer's edge metal products, and other singlesource components of roofing system marketed by the manufacturer. 2. Guarantee Period: 20 years from date of Substantial Completion. 3. Contractor is required to list "CIDA, INC." as the Specifier/Consultant of record in the appropriate fields ("Specifier Account") when applying for the manufacturer's warranty. B. Installer's Guarantee: Submit roofing Installer's guarantee, including all components of roofing system for the following guarantee period: 1. Guarantee Period: Two years from date of Substantial Completion. C. Existing Guarantees: Guarantees on existing building elements should not be affected by scope of work. 1. Installer is responsible for coordinating with building owner's representative to verify compliance						
077221	Roof Hatch				Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge						
077222	Roof Hatch Rail System				Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase.Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge						
DIVISION 9 - FINISHES											
092900	Gypsum Board				1 year warranty						
096519	Resilient Tile Flooring		maintenance data		1 year warranty						
096813	Tile Carpeting		Product Data and Care		Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within lifetime of product. Warranty shall include stain resistance.		Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).				
099123	Interior Painting		Product Data and Care		1 year warranty		Quantity: Furnish an additional 1 gal. (3.8 L) of each material and color applied.				
DIVISION 23 - HVAC											
230000	Basic HVAC Requirements		Prior to final inspection, provide one (1) electronic copy of manufacturer's maintenance manuals for each piece of equipment or items requiring service. Manual shall include manufacturer's operation and maintenance instruction manuals and parts list for each piece of equipment or item requiring servicing.Include in the manual manufacturer's service data, wiring diagrams and parts lists for all major items of equipment, valve charts, balancing data, final control diagrams showing final set points and any additional equipment added by contract modification. Comply with provisions of Section 01700 where applicable. B. Prepare project cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of file when multiple files are required.  C. Internally subdivide the file contents with section dividers, logically organized with electronic bookmarks. D. Provide one (1) final copy of manual in electronic pdf format through owner's eBuilder Closeout Process system after approval of contents.		Provide a written guaranty covering the work of this Division for a period of one calendar year form the data of acceptance of the entire project as required by the General Provisions. B. Provide manufacturer's written warranties for material and equipment furnished under this Division insuring parts and labor for a period of one year minimum, or longer as required by other sections, from the date of acceptance of the entire project. C. Correct warranty items promptly upon notification.						
230500	Basic Materials and Methods				1 year warranty						
230510	Pipe and pipe fittings				1 year warranty						
230523	Valves		Product Data		1 year warranty						
230529	Supports and Anchors				1 year warranty						

	e-B Project number 8286		REQUIREMENTS PER SPECIFICATIONS (YES/NO)								
SPEC SECTION	SPECIFICATION DESCRIPTION	SUBCONTRACTOR	O&M	Recvd	WARRANTY	Recvd	EXTRA STOCK MATERIAL	Recvd	OWNER TRAINING	Recvd	AS-BUILT
230593	Testing, Adjusting, and Balancing for HVAC		Provide reports		1 year warranty						
230700	Mechanical Insulation				1 year warranty						
230800	Comissioning		Prior to substantial completion, the Commissioning Provider shall review the O&M manuals for systems that were commissioned to verify compliance with the specifications. The Commissioning Provider will communicate deficiencies in the manuals to the Commissioning Team. 2. The Commissioning Provider will also review each equipment warranty and verify that requirements to keep the warranty valid are clearly stated. 3. This work does not supersede the Design Team's review of the O&M manuals.						The Trade Subcontractors are responsible to provide training for facility personnel per the Contract Documents. The Trade Subcontractors shall work with the Commissioning Provider to develop appropriate training and orientation agendas for equipment and systems and provide skilled trainers for the sessions. The Commissioning Provider will verify that the Trade Subcontractors execute training per the Contract Documents		
230923	Direct Digital Control System				Warranty shall cover all costs for parts, labor, and associated travel, and expenses for a period of three (3) years from completion of system demonstration and training. B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the Vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours. C. This warranty shall apply equally to both hardware and software..				Provide application engineer to instruct owner in operation of systems and equipment. B. Provide basic operator training for a minimum of 3 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. C. Provide training above as required up to twenty-four (24) hours in four (4) six (6) hour blocks as part of this contract. A. Provide systems demonstration under provisions of Section 23 0000. B. Demonstrate complete and operating system to Owner's Representative. C. Provide certificate stating that control system has been tested and adjusted for proper operation.		
232100	Hydronic Systems		operation and maintenance data								
233300	Air Distribution		operation and maintenance data								
237000	HVAC		Submit operation and maintenance data under provisions of Section 23 0500. B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.		1 year warranty						
238110	Variable Refrigerant Flow Heat Pump				System and component warranty shall comply with Beaverton School District requirements but not less than 2 years for installation and general system and 5 years for all sealed components						
238120	Variable Refrigerant Flow Heat Recovery				System and component warranty shall comply with Beaverton School District requirements but not less than 2 years for installation and general system and 5 years for all sealed components						
DIVISION 26 - ELECTRICAL											
260500	Common work results for electrical		Provide product cut sheet, installation instructions, operating/programming instructions, a parts list with local suppliers, shop drawings, one-lines, diagrams, warranties, and a local repair/maintenance provider. Provide all required submittal data in PDF "e-book" format. 2. Provide copies of certificates of code authority acceptance, test data, product data, guarantees, warranties, and the like. 3. Provide one (1) copy of the O&M manual after the approval of the electronic version through eBuilder Closeout Process.		Ensure all equipment is warranted free of defects in materials and workmanship. B. Manufacturer's warranty is in addition to, not a limitation of, other rights the Owner may have under contract documents. C. As a condition precedent to the final payment, execute a written guarantee (warranty) to the owner certifying all contract requirements have been met according to the contract. Written guarantee is to ensure all materials and equipment furnished under this contract are to remain in satisfactory operating condition (normal wear/tear and owner abuse excluded) for one (1) year from the date the Contractor received written notification of final acceptance from the owner.				For each distinct electrical system provide training for the building owner and their staff. Coordinate detail and level of training required for each system to ensure owner is satisfied. At minimum provide four hours of training per distinct system with factory trained representatives as applicable, ensure training includes but is not limited to training documentation, hands on instruction, examples, and Q&A. Coordinate with owner to schedule training time. 2. Provide minimum of 1-year of 24/7 phone support for system operation as part of system training. 1 year of support starts at time of owner's final acceptance of the systems. Ensure phone support is qualified and available to answer and work through system training questions as needed to meet the satisfaction of the owner. The phone support is in addition to any warranty or other rights guaranteed to the owner.		



e-B Project number 8286			REQUIREMENTS PER SPECIFICATIONS (YES/NO)								
SPEC SECTION	SPECIFICATION DESCRIPTION	SUBCONTRACTOR	O&M	Recvd	WARRANTY	Recvd	EXTRA STOCK MATERIAL	Recvd	OWNER TRAINING	Recvd	AS-BUILT
260519	Low-voltage electrical power conductors and cables				Ensure all equipment is warranted free of defects in materials and workmanship. B. Manufacturer's warranty is in addition to, not a limitation of, other rights the owner may have under contract documents. C. As a condition precedent to the final payment, execute a written guarantee (warranty) to the owner certifying all contract requirements have been met according to the contract. Written guarantee is to ensure all materials and equipment furnished under this contract are to remain in satisfactory operating condition (normal wear/tear and owner abuse excluded) for one (1) year from the date the Contractor received written notification of final acceptance from the owner.						
260526	grounding and bonding for electrical systems				Ensure all equipment is warranted free of defects in materials and workmanship. B. Manufacturer's warranty is in addition to, not a limitation of, other rights the owner may have under contract documents. C. As a condition precedent to the final payment, execute a written guarantee (warranty) to the owner certifying all contract requirements have been met according to the contract. Written guarantee is to ensure all materials and equipment furnished under this contract are to remain in satisfactory operating condition (normal wear/tear and owner abuse excluded) for one (1) year from the date the Contractor received written notification of final acceptance from the owner.						
260529	Hangers and supports for electrical systems				Ensure all equipment is warranted free of defects in materials and workmanship. B. Manufacturer's warranty is in addition to, not a limitation of, other rights the owner may have under contract documents. C. As a condition precedent to the final payment, execute a written guarantee (warranty) to the owner certifying all contract requirements have been met according to the contract. Written guarantee is to ensure all materials and equipment furnished under this contract are to remain in satisfactory operating condition (normal wear/tear and owner abuse excluded) for one (1) year from the date the Contractor received written notification of final acceptance from the owner.						
260533	Raceway and boxes for electrical systems				Ensure all equipment is warranted free of defects in materials and workmanship. B. Manufacturer's warranty is in addition to, not a limitation of, other rights the owner may have under contract documents. C. As a condition precedent to the final payment, execute a written guarantee (warranty) to the owner certifying all contract requirements have been met according to the contract. Written guarantee is to ensure all materials and equipment furnished under this contract are to remain in satisfactory operating condition (normal wear/tear and owner abuse excluded) for one (1) year from the date the Contractor received written notification of final acceptance from the owner.						
260553	Identification for Electrical Systems				Ensure all equipment is warranted free of defects in materials and workmanship. B. Manufacturer's warranty is in addition to, not a limitation of, other rights the owner may have under contract documents. C. As a condition precedent to the final payment, execute a written guarantee (warranty) to the owner certifying all contract requirements have been met according to the contract. Written guarantee is to ensure all materials and equipment furnished under this contract are to remain in satisfactory operating condition (normal wear/tear and owner abuse excluded) for one (1) year from the date the Contractor received written notification of final acceptance from the owner.						
262400	Switchboards and panelboards				Ensure all equipment is warranted free of defects in materials and workmanship. B. Manufacturer's warranty is in addition to, not a limitation of, other rights the owner may have under contract documents. C. As a condition precedent to the final payment, execute a written guarantee (warranty) to the owner certifying all contract requirements have been met according to the contract. Written guarantee is to ensure all materials and equipment furnished under this contract are to remain in satisfactory operating condition (normal wear/tear and owner abuse excluded) for one (1) year from the date the Contractor received written notification of final acceptance from the owner.						

[illegible]

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operations and Maintenance Manual.
- B. See Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

### 1.2 SUBMITTALS

- A. Manual: Submit electronic manual in final form at least 15 days before final inspection. Architect/Consultant and Owner's Representative will return an electronic copy with comments within 15 days after final inspection.
  - 1. Correct or modify each manual to comply with Architect's comments. Submit final electronic copy of each corrected manual within 15 days of receipt of Architect's/Consultant's and Owner's Representative's comments.

## PART 2 - PRODUCTS

### 2.1 MANUAL, GENERAL

- A. Organization: Unless otherwise indicated, organize manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. The manual shall contain a title page, table of contents, and manual contents.
- B. Title Page: Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name, address, and telephone number of Contractor.
  - 6. Name and address of Architect.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Arrange contents numerically by specification section.

OPERATION INFORMATION

- E. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
- F. Descriptions: Include the following:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Equipment identification with serial number of each component.
  - 4. Equipment function.
  - 5. Operating characteristics.
  - 6. Limiting conditions.
  - 7. Performance curves.
  - 8. Engineering data and tests.
  - 9. Complete nomenclature and number of replacement parts.
- G. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
- H. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- I. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

PRODUCT MAINTENANCE INFORMATION

- J. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- K. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- L. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- M. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.

- N. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- O. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

#### SYSTEMS AND EQUIPMENT MAINTENANCE INFORMATION

- P. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- Q. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- R. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
- S. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:
- T. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- U. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- V. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- W. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

### PART 3 - EXECUTION

#### 3.1 MANUAL PREPARATION

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

OPERATION AND MAINTENANCE DATA  
SECTION 017823

- B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- C. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- D. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
- E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
- B. See Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- C. See Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

### 1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit copies of Record Drawings as follows:
    - a. Submit one set of marked-up Record Prints, and the following:
      - 1) Record CAD Drawing Files and Plots: One set.
      - 2) Copies printed from Record CAD Drawing Plots: Three. Plot and print each Drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one copy copies of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal.

## PART 2 - PRODUCTS

### 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
  - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
  2. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
  3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record CAD Drawings: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect. When authorized, prepare a full set of corrected CAD Drawings of the Contract Drawings, as follows:
1. Format: Same CAD program, version, and operating system as the original Contract Drawings.
  2. Incorporate changes and additional information previously marked on Record Prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Architect for resolution.
  4. Architect will furnish Contractor one set of CAD Drawings of the Contract Drawings for use in recording information.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize Record Prints and newly prepared Record Drawings into single PDF file.
  2. Record Transparencies: Organize into unbound sets matching Record Prints. Place transparencies in durable tube-type drawing containers with end caps. Mark end cap of each container with identification. If container does not include a complete set, identify Drawings included.
  3. Record CAD Drawings: Organize CAD information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each CAD file.
  4. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

## 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.



1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

## 2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

## 2.4 MISCELLANEOUS RECORD SUBMITTALS

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

# PART 3 - EXECUTION

## 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION

PART 1 - GENERAL

1.1 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to Final Completion or acceptance, fully instruct the Owner's Designated Representative and maintenance personnel in the operation, adjustment, and maintenance of all products, equipment, and systems.
  - 1. The District reserves the right to videotape training sessions.
- B. Operating and maintenance manual shall constitute the basis of instruction.
  - 1. Review contents of manual with Owner's personnel in full detail to explain all aspects of operations and maintenance.
  - 2. Review complete heating and cooling cycles with Owner's Designated Representative. Review location of dampers, valves, and control equipment.

END OF SECTION

## 1 GENERAL

## 1.01 PURPOSE

- A. This Section includes the general requirements that apply to the implementation of the commissioning process.
- B. Commissioning is a systematic process that provides documented confirmation that the building systems perform according to the criteria set forth in the design intent defined in the Basis of Design and satisfy the operational needs defined in the Owner's Project Requirements.
- C. Commissioning during the construction phase is intended to achieve the following specific objectives:
  - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by the installing contractors.
  - 2. Verify and document proper performance of equipment and systems.
  - 3. Verify that O&M documentation left on site is complete.
  - 4. Verify that the Owner's operating personnel are adequately trained.

## 1.02 ABBREVIATIONS

A/E-	Architect and design engineers	GC-	General contractor (prime)
CxA-	Commissioning authority	MC-	Mechanical contractor
CC-	Controls contractor	OR-	Owner's Representative
CM-	Construction Manager	PFC-	Pre-functional checklist
Cx-	Commissioning	PM-	Project manager (of the Owner)
EC-	Electrical contractor	Subs-	Subcontractors to General
FTP-	Functional Test Procedure	TAB-	Test and balance contractor

## 1.03 DEFINITIONS

- A. Owner's Project Requirements (OPR): A document that details the functional requirements of a project and the expectations of how it will be used and

operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

- B. Basis of Design (BOD) Basis of Design: A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- C. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process as dictated by the Commissioning Specification.
- D. Pre-Functional Checklist (PFC): A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the contractors. Pre-functional 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 pre-functional 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 pre-functional refers to before functional testing. Pre-functional 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 pre-functional checklist items a commissioning authority 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 authority only requires that the procedures be documented in writing and does not witness much of the pre-functional checklist completion, except for larger or more critical pieces of equipment.
- E. Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.
- F. Functional Test Procedure (FTP): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is 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). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation

and components are verified to be responding as the sequences state. 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 testing is verifying that which has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FTPs are performed after pre-functional checklists and startup are complete.

- G. Issue Log (IL): A formal and ongoing record of problems or concerns – and their resolution – that has been raised by members of the Commissioning Team during the course of the Commissioning Process.

#### 1.04 RELATED WORK SPECIFIED ELSEWHERE

A. Division 01 – General

1. 013100 Project Management and Coordination
2. 013300 Submittal Procedures
3. 017700 Closeout Procedures
4. 017823 Operation and Maintenance
5. 017900 Demonstration and Training

B. Division 23 – HVAC

1. 230500 Basic Materials and Methods
2. 230593 Testing, Adjusting, and Balancing
3. 230800 Commissioning of HVAC
4. 230900 Direct Digital Control System
5. 232100 Hydronic Systems
6. 233113 Air Distribution
7. 237000 HVAC
8. 238110 Variable Refrigerant Flow Heat Pump
9. 238120 Variable Refrigerant Flow Heat Recovery

#### 1.05 RESPONSIBILITIES

A. Owner & Owner Representatives

1. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions.
2. Provide final approval for the completion of the commissioning work.

3. Ensure that any seasonal or deferred testing and any deficiency issues are addressed.
4. Attend commissioning kickoff meetings and additional meetings as necessary.

B. Commissioning Authority

1. The primary role of the CxA is to ensure that the commissioned systems meet the owner's project requirements and function according to the design intent. The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E.
  - a. Coordinates and directs the commissioning activities
  - b. Develops and updates the following commissioning documentation as necessary:
    - 1) Commissioning Plan
    - 2) Pre-functional Checklists (PFC)
    - 3) Commissioning Site Observation Reports
    - 4) Functional Test Procedures (FTP)
    - 5) Completed Functional Test Procedure (FTP) - as witnessed
    - 6) Issue Log (IL)
    - 7) Commissioning Report
  - c. Reviews and provides input on the following commissioning documentation:
    - 1) Commissioning Schedule
    - 2) Commissioning Agenda and Meeting Minutes
    - 3) Equipment and Control Submittal related to commissioned systems
    - 4) Completed Pre-functional Checklists (PFC)
    - 5) Start-up Reports

- 6) Training Agendas and completion verifications
  - 7) Operation and Maintenance Manuals related to commissioned systems
  - 8) Warranties related to commissioned systems
  - d. Attend commissioning Kickoff meeting and other commissioning meetings.
  - e. Perform site visits, as necessary, to observe component and system installations.
  - f. Direct and witness functional testing as conducted by installing contractors.
  - g. Analyze functional test procedure, trend logs and monitoring data to verify satisfactory operation.
- C. Deferred Testing Coordination Engineer of Record
- 1. The EOR shall participate in and perform commissioning process activities including, but not limited to, the following:
    - a. Attend the commissioning kickoff meeting and selected commissioning team meetings.
    - b. Provide a Basis of Design.
    - c. Participate in the resolution of system deficiencies identified during commissioning.
    - d. Participate in the resolution of design non-conformance and design deficiencies identified during Functional testing and warranty-period commissioning.
- D. General Contractor
- 1. Contractor shall assign a representative with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
    - a. Designate a Commissioning coordinator.
    - b. Coordinate and attend commissioning team meetings held on a periodic basis. Create a meeting agenda for distribution prior to the meeting and document the meetings minutes.
    - c. Ensure and coordinate the participation of the subcontractors in the Commissioning process.

- d. Track completion of equipment start up and forward start up reports generated by contractor to CxA at least 7 days prior to functional testing.
- e. Track completion of test and balance and forward test and balance report generated by contractor to CxA at least 7 days prior to functional testing.
- f. Coordinate the completion of the Pre-functional checklists (PFC) by the Discipline Specific Contractors and submit completed forms to the CxA for approval.
- g. Review and accept commissioning process test procedures provided by the CxA.
- h. Coordinate all necessary parties for scheduled functional testing.
- i. Coordinate access to all commissioned system components as necessary for CxA to witness functional test procedures.
- j. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
- k. Review and follow procedures outlined in the Commissioning Plan.
- l. Track completion of resolution of issues recorded in the Issue Log. Coordinate installing contractor's responses and updates to Issue Log.
- m. Integrate and coordinate commissioning process activities with commissioning schedule based upon the construction schedule. Identify other activities that may impede the commissioning process (air barrier testing, TAB, fire alarm testing, etc..)
- n. Coordinate the training of Owner personnel and provide the times and dates of training to the CxA. Provide training agendas prior to training and evaluation forms completed by training participants to the CxA.
- o. Deferred Testing participation.

E. Subcontractors

- 1. Subcontractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
  - a. Attend commissioning kickoff meetings and additional meetings as necessary.



- b. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
- c. Complete their related sections on the Pre-functional Checklists (PFC).
- d. Perform the test procedures laid out in the Functional Test Procedures (FTP) for pretesting prior to final testing witness by the CxA.
- e. Perform the test procedures laid out in the Functional Test Procedures (FTP) for witness by the CxA.
- f. Review and follow procedures outlined in the Commissioning Plan.
- g. Provide requested graphical trends to the CxA for demonstration of system performance and incorporation into the CxA documentation.
- h. 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 data logging equipment that may be used by the CxA.
- i. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
- j. Review test procedures for equipment installed by factory representatives.
- k. Deferred Testing participation.

F. Equipment Supplier

- 1. The equipment suppliers shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
  - a. Assist in equipment testing per agreements with Subs.
  - b. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
  - c. Review test procedures for equipment installed by factory representatives.
  - d. Attend commissioning kickoff meetings and additional meetings as necessary.

## 1.06 SYSTEMS TO BE COMMISSIONED

Category	Systems/Equipment
<b>HVAC</b>	Dedicated Outside Air Handling Unit
	Variable Refrigerant Flow Heat Pumps
	Variable Refrigerant Flow Condensing Units
	Packaged Rooftop Air Handling Units
	Exhaust Fans
	Makeup Air Unit
	Electric Unit Heaters
	Destratification Fans
	Electric Wall Heaters
	Kitchen Exhaust Hood/Fans
	Direct Digital Controls

## 1.07 CODES AND STANDARDS

- A. BCA guidelines
- B. ASHRAE commissioning guidelines
- C. ACG guidelines

## 2 PRODUCTS

## 2.01 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional test procedures shall be provided by the Contractor. Two-way radios shall be provided by the Contractor when necessary.
- B. Special equipment, tools, test gas, and instruments required for testing equipment shall be provided by the Contractor.

- C. All testing equipment shall be of sufficient quality and accuracy to test and/or 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 to an accuracy of 0.5°F and a resolution of  $\pm 0.1^\circ\text{F}$ . Pressure sensors shall have an accuracy of  $\pm 2.0\%$  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.

### 3 EXECUTION

#### 3.01 COMMISSIONING TEAM:

- A. The members of the commissioning team consist of the Commissioning authority (CxA), the Owner's Representative (OR), the designated representative of the owner's Construction Management firm (CM), the General Contractor commissioning coordinator (GC), the architect and design engineers (AE & EOR), the designated representative of the Mechanical Contractor (MC), the designated representative of the Electrical Contractor (EC), the TAB representative, the designated representative of the Controls Contractor (CC), any other installing discipline contractors or suppliers of equipment. If known, the Owner's building or plant operator/engineer is also a member of the commissioning team.

#### 3.02 COMMISSIONING PLAN:

- A. The CxA will develop the commissioning plan with review and input from the rest of the Commissioning Team.

#### 3.03 COMMISSIONING KICK OFF MEETING:

- A. An initial kick off meeting organized by the General Contractor Commissioning Coordinator (GC) and facilitated by the Commissioning Authority (CxA) during construction where the commissioning process is reviewed with the project commissioning team members.

#### 3.04 COMMISSIONING SCHEDULE:

- A. The GC will be required to maintain a commissioning schedule that is updated periodically during the commissioning process and is presented and discussed at the commissioning meetings.

- B. Include the following typical types of milestone and predecessors:
1. Utilities Available
  2. System Readiness (by system)
    - a. Utilities available to equipment (water, power, gas)
    - b. Equipment Startup
    - c. Controls Point to Point
    - d. Test and Balancing
    - e. Functional Test Procedures
  3. Conflicting construction activities (preventing Cx activities), some examples as follows:
    - a. Fire alarm testing
    - b. Air barrier testing
    - c. Air quality measuring
- C. The schedule shall be submitted to the CxA for review and discussion during the Commissioning Meetings.
- 3.05 COMMISSIONING MEETINGS:
- A. Periodic meeting held during construction organized and managed by the GC to plan, scope, coordinate, and schedule future activities and resolve problems with the commissioning team members.
- 3.06 SUBMITTALS:
- A. Equipment documentation shall be submitted to the CxA from the GC to detail startup procedures.
- 3.07 STARTUPS:
- A. The CxA may witness startup of selected equipment identified in the Commissioning Plan. Scheduling of these startups shall be incorporated into the Commissioning Schedule.
- 3.08 PRE-FUNCTIONAL CHECKLIST (PFC):
- A. The CxA will develop the PFCs with review and input from the Commissioning Team. After equipment is installed, the PFCs shall be filled out by the EC, MC, and the CC. The GC shall verify the completion of the forms prior to submitting them to the CxA. The submission of the PFC is an indication that the equipment is ready to begin functional Test Procedures (FTP).

- B. Contractor will conduct independent start up and testing. Contractor completes manufacturer start up documentation which covers basic component set up, calibration, and functionality which shall be prerequisite to functional test procedures.
- C. Only field individuals that have direct knowledge and witnessed that a line item task on the PFC was actually performed shall initial or check that item.

### 3.09 TEST DOCUMENTATION:

- A. TAB report:
  - 1. Prior to functional testing, certified and approved TAB report shall be submitted to the CxA for review.
  - 2. The CxA may verify the TAB report for verification equipment performance. At the request of the CxA, the contractor will be available on the jobsite and with the same portable measurement instrument used during balancing, start-up and to verify 10% of the report values in the field.
- B. DDC point to point (For BAS, FMS, EPMS)
  - 1. CC shall submit a point to point checkout report that verifies all the end to end device conditions. Checkout report shall verify all installation of end device, wiring between device and controller and controller software is configured correctly reflected in the software.

### 3.10 SITE OBSERVATIONS:

- A. The CxA will periodically perform site visits, as necessary, to observe component and system installations. Deficiencies will be identified in the Issue Log and discussed at Commissioning Meetings.

### 3.11 FUNCTIONAL TEST PROCEDURES (FTP):

- A. The CxA develops the FTPs based upon the sequence of operations laid out in the contract documents and approved control submittal and with review and input from the rest of the Commissioning Team.
- B. It is important that the GC, EC, MC, and CC review the FTPs for consistency with the current contract document requirements. Lack of coordination on the FTP may result in retesting and delay the commissioning process.
- C. Once the PFCs have been completed, the GC shall schedule testing with the CxA and Owner at least 7 days in advanced.

- D. The GC shall ensure that the systems have been pretested by the installing contractor according to the approved FTP to ensure that systems are operating properly and to avoid retesting.

### 3.12 NON-CONFORMANCE.

- A. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be identified on the AL.
- B. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.
- C. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.

### 3.13 RETESTING:

- A. If a functional test procedure has been unable to be satisfactorily completed, it will need to be retested.
- B. Once the non-conformance has been resolved, the GC shall schedule test witnessing with the CxA and Owner at least 7 days in advance.
- C. Cost of Retesting.
  - 1. The cost for the subcontractor to retest a pre-functional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.
  - 2. For a deficiency identified, not related to any pre-functional checklist or start-up fault, the following shall apply: The CxA will direct the retesting of the equipment once at no additional cost. However, the Owner may charge the GC for the CxA's time for a second retest.
  - 3. The time for the CxA to direct any retesting required because a specific *pre-functional* checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be deficient, may be charged by the Owner to the GC.

### 3.14 DEFERRED TESTING

- A. Unforeseen Deferred Tests occur if any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of

the OR. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

- B. Seasonal Testing occurs if any testing is delayed until the weather conditions are closer to the system's design. During the warranty period, seasonal testing shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-builds due to the testing will be made.

END OF SECTION

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
  - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."



## 2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type II. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class C or F.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
  - 2. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag cement.
- B. Normal-Weight Aggregates: ASTM C 33, graded, 1-1/2-inch nominal maximum coarse-aggregate size.
  - 1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.4 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Water: Potable.
- C. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

## 2.5 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 3000 psi at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.45
  - 3. Slump Limit: 4 inches (100 mm), 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
  - 4. Air Content: 5 percent, plus or minus 1.5 percent at point of delivery.

## 2.6 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

3.4 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

3.5 FINISHING FORMED SURFACES

- A. As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

3.6 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.7 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

END OF SECTION 033000

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Framing with dimension lumber.
  - 2. Framing with glulam beams.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
  - 3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Glulam Beams: Provide beams with dimensions and combination construction indicated on structural drawings.

### 2.2 DIMENSION LUMBER FRAMING

- A. Maximum Moisture Content: 19 percent.
- B. No. 2 grade Douglas fir-larch; WCLIB or WWPA.
  - 1.

### 2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified.
- B. Bolts: Steel bolts complying with ASTM A 307, Grade A with ASTM A 563 hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

END OF SECTION 061000

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Plastic-laminate cabinets and cubbies.
- B. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips unless concealed within other construction before woodwork installation.

1.2 SUBMITTALS

- A. Product Data: For cabinet hardware and accessories, and finishing materials and processes.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- C. Samples:
  - 1. Plastic-laminates, for each type, color, pattern, and surface finish.
- D. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of woodwork.
- B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards."
  - 1. Provide AWI Quality Certification Program labels and certificates for woodwork, including installation.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 WOODWORK FABRICATORS

- A. Fabricators: Provide interior architectural woodwork by a qualified fabricator with a minimum of five (5) years of experience with cabinetry fabrication.

### 2.2 MATERIALS

- A. Wood Products:
  - 1. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
- B. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

### 2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural woodwork, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Hospital grade overlay hinges required. RPC 374-26D or equal.
- C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter, 2-1/2 inches deep.

### 2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

### 2.5 FABRICATION

- A. General: Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting. Provide "T" molding on all exposed edges of cabinets, cubbies and/or other casework.
  - 1. Interior Woodwork Grade: Custom.
  - 2. Shop cut openings to maximum extent possible. Sand edges of cutouts to remove splinters and burrs. Seal edges of openings in countertops with a coat of varnish.



B. Plastic-Laminate Cabinets and Cubbies:

1. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate as follows:
  - a. Horizontal Surfaces Other Than Tops: Grade HGS.
  - b. Postformed Surfaces: Grade.
  - c. Vertical Surfaces: Grade HGS.
  - d. Edges: "T" Mold
2. Materials for Semiexposed Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS
3. Colors, Patterns, and Finishes: As selected by Architect from Manufacturer's full range.
4. The shell and horizontal members of cubbies shall be constructed of ¾" MDO.
5. Where shelves exceed 24" unsupported span, fabricate with 1" MDO.
6. Vertical dividers shall be constructed of ½" MDO.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.
- B. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- C. Install woodwork level, plumb, true, and straight to a tolerance of 1/8 inch in 96 inches. Shim as required with concealed shims.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
  1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips and No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Calk space between backsplash and wall with interior grade sealant.

END OF SECTION 064023

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Adhered EPDM membrane roofing system (Re-cover and Re-Roof systems).
- B. Cover board.
- C. Roof insulation.
- D. Vapor retarder.
- E. Base Sheet.
- F. Substrate board.

1.2 RELATED SECTIONS

- A. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, cants, curbs, and blocking.
- B. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counter flashings.

1.3 REFERENCES

- A. Roofing Terminology: Refer to the following publications for definitions of roofing work related terms used in this Section:
  - 1. ASTM D 1079 "Standard Terminology Relating to Roofing and Waterproofing."
  - 2. Glossary of NRCA's "The NRCA Roofing Manual."
  - 3. Roof Consultants Institute "Glossary of Roofing Terms."
- B. Sheet Metal Terminology and Techniques: SMACNA "Architectural Sheet Metal Manual."

1.4 DESIGN CRITERIA

- A. General: Installed roofing membrane systems shall remain watertight; and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Roofing materials shall be compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.
- C. Installer must comply with current code requirements based on authority having jurisdiction.

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- D. Wind Uplift Performance: Roofing system shall be identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist wind uplift pressure calculated in accordance with ASCE 7. Wind uplift as determined by roofing manufacturer for project locale.
- E. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
  - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.

1.5 SUBMITTALS

- A. Product Data: Manufacturer's data sheets for each product to be provided.
- B. Detail Drawings: Provide roofing system plans, elevations, sections, details, and details of attachment to other Work, including:
  - 1. Base flashings, cants, and membrane terminations.
  - 2. Tapered insulation, including slopes.
  - 3. Crickets, saddles, and tapered edge strips, including slopes.
  - 4. Insulation fastening patterns.
- C. Verification Samples: Provide for each product specified.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- E. Maintenance Data: Refer to manufacture's latest published documents on their website.
- F. Guarantees: Provide manufacturer's current guarantee specimen.
- G. Prior to beginning the work of this section, roofing sub-contractor shall provide a copy of the final System Assembly Letter issued by selected roofing manufacturer indicating that the products and system to be installed shall be eligible to receive the specified manufacturer's guarantee when installed by a certified contractor in accordance with our application requirements, inspected and approved by a certified roofing manufacturer's technical representative.
- H. Prior to roofing system installation, roofing sub-contractor shall provide a copy of the Guarantee Application Confirmation document issued by manufacturer indicating that the project has been reviewed for eligibility to receive the specified guarantee and registered.
  - 1. "CIDA, INC." must be listed as the Specifier/Consultant of record in the appropriate fields on the Guarantee Application Confirmation.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and is eligible to receive the specified manufacturer's guarantee.
- B. Manufacturer Qualifications: Qualified manufacturer that has UL listing for roofing system identical to that used for this Project.
- C. Testing Agency Qualifications: Independent testing agency with the experience and capability to conduct the testing indicated, as documented in accordance with ASTM E329.
- D. Test Reports:
  - 1. Roof drain and leader test or submit plumber's verification.
  - 2. Core cut (if requested).
  - 3. Roof deck fastener pullout test.
- E. Moisture Survey (Re-cover Only):
  - 1. Submit prior to installation, results of a non-destructive moisture test of roof system completed by approved third party. Utilize one of the approved methods:
    - a. Infrared Thermography
    - b. Nuclear Backscatter
- F. Source Limitations: Obtain all components from the single source roofing system manufacturer guaranteeing the roofing system. All products used in the system must be labeled by the single source roofing system manufacturer issuing the guarantee.
- G. Fire-Test-Response Characteristics: Roofing materials shall comply with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when current and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written instructions and guarantee requirements.

1.9 GUARANTEES

- A. Provide manufacturer's system guarantee as follows:
1. Single-Source special guarantee includes roofing membrane, base flashings, roofing membrane accessories, **roof insulation, fasteners, cover board, substrate board, vapor retarder, walkway products, manufacturer's edge metal products**, and other single-source components of roofing system marketed by the manufacturer.
  2. Guarantee Period: **20** years from date of Substantial Completion.
  3. Contractor is required to list "CIDA, INC." as the Specifier/Consultant of record in the appropriate fields ("Specifier Account") when applying for the manufacturer's warranty.
- B. Installer's Guarantee: Submit roofing Installer's guarantee, including all components of roofing system for the following guarantee period:
1. Guarantee Period: Two years from date of Substantial Completion.
- C. Existing Guarantees: Guarantees on existing building elements should not be affected by scope of work.
1. Installer is responsible for coordinating with building owner's representative to verify compliance.

PART 2 - PRODUCTS

2.1 ETHYLENE PROPYLENE DIENE MONOMER ROOFING MEMBRANE - EPDM

- A. Non-reinforced uniform, flexible sheet made from Ethylene Propylene Diene Monomer, ASTM D 4637, Type I.

Basis of Design: EPDM NR by JOHNS MANSVILLE,

1. Thickness (minimum): 90 mils
  2. Exposed Face Color: White.
  3. Factory Inseam Tape: **6-inch (150-mm)** wide minimum, butyl splice tape with release film.
- B. Scrim or fabric internally reinforced uniform, flexible sheet made from Ethylene Propylene Diene Monomer, ASTM D 4637, Type II.
1. Thickness (minimum): 90 mils
  2. Exposed Face Color: White.

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3. Factory Inseam Tape: **6-inch (150-mm)** wide minimum, butyl splice tape with release film.

## 2.2 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
  1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
  2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Plastic Foam Adhesives: 50 g/L.
    - b. Gypsum Board and Panel Adhesives: 50 g/L.
    - c. Multipurpose Construction Adhesives: 70 g/L.
    - d. Fiberglass Adhesives: 80 g/L.
    - e. Contact Adhesive: 80 g/L.
    - f. Single-Ply Roof Membrane Sealants: 450 g/L.
    - g. Nonmembrane Roof Sealants: 300 g/L.
    - h. Sealant Primers for Nonporous Substrates: 250 g/L.
    - i. Sealant Primers for Porous Substrates: 775 g/L.
    - j. Other Adhesives and Sealants: 250 g/L.
- B. Sheet Flashing: 90-mil thick EPDM, partially cured or cured, according to application. Manufacturer's sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane.
- C. Primer Material: Manufacturer's standard synthetic-rubber polymer primer.
- D. Seaming Material: Manufacturer's standard **6-inch- (150-mm-)** wide minimum, butyl splice tape with release film.
- E. Sealing Strip: Manufacturer's standard **12-inch- (300-mm-)** wide, 45 mil (1.14 mm) thick minimum, cured EPDM with factory-laminated, self-adhering seam tape.
- F. Bonding Adhesive: Manufacturer's standard water-based bonding adhesive for membrane and base flashings. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.
- G. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, with anchors.
- H. Membrane Battens: Manufacturer's standard polymer or aluminum-zinc-alloy-coated steel sheet, pre-punched.
- I. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

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- J. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, sealants and other accessories.

2.3 AUXILIARY ROOFING SYSTEM COMPONENTS

- A. Coping System: Manufacturer's factory fabricated coping consisting of a base piece and a snap-on cap. Provide product manufactured and marketed by single-source membrane supplier that is included in the No Dollar Limit guarantee.
- B. Fascia System: Manufacturer's factory fabricated fascia consisting of a base piece and a snap-on cover. Provide product manufactured and marketed by single-source membrane supplier that is included in the No Dollar Limit guarantee.
- C. Metal/Membrane Flashing: Specially designed and manufactured flashing for sealing and waterproofing.
- D. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."

2.4 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads sourced from membrane roofing system manufacturer.

2.5 COVER BOARD

- A. High-Density Polyisocyanurate: ASTM C 1289, Type II, Class 4, Grade 3, High-density Polyisocyanurate technology bonded in-line to mineral-surfaced, fiber glass reinforced facers with greater than 140 lbs of compressive strength.

2.6 ROOF INSULATION

- A. General: Preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class **3**, Grade **3 (25 psi)**
  - 1. Provide insulation package with minimum R Value: 21
  - 2. Provide insulation package in multiple layers.
  - 3. Minimum Long-Term Thermal Resistance (LTTR): 5.7 per inch.
    - a. Determined in accordance with CAN/ULC S770 at 75°F (24°C)



2.7 TAPERED INSULATION

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

2.8 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Provide factory preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and furnished by roofing system manufacturer.
- D. Polymer Auger Fasteners: Glass-reinforced nylon fasteners with 1/4" square drive and 1" head with Galvalume®-coated 2" metal stress plates, designed to lock into the fastener head. Fasteners designed for fastening roof insulation to substrate, and furnished by roofing system manufacturer.
- E. Urethane Adhesive: Manufacturer's two component polyurethane adhesive formulated to adhere insulation to substrate.
- F. Wood Nailer Strips: Comply with requirements in Division 06 Section "Miscellaneous Rough Carpentry."

2.9 VAPOR RETARDER

- A. Glass-Fiber Felts: ASTM D 2178, Type IV, asphalt-impregnated, glass-fiber felt. Basis of Design: GlasPly IV

2.10 BASE-SHEET MATERIALS

- A. Base Sheet: ASTM D 4601, Type II non-perforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.
- B. Polymer Auger Fasteners: Glass-reinforced nylon fasteners with 1/4" square drive and 1" head with Galvalume®-coated 2" metal stress plates, designed to lock into the fastener head. Fasteners designed for fastening roof insulation to substrate, and furnished by roofing system manufacturer. Basis of Design: Polymer Auger Fasteners and Plates

2.11 SUBSTRATE BOARD

- A. Substrate Board: ASTM C 728, perlite board, 1 inch (25 mm) thick, seal coated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

1. General:

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

2. Wood Decks:

- a. Verify that wood decking is visibly dry and free of moisture according to manufacturer's approved method.
- b. Verify that wood has ability to provide minimum fastener pull-out resistance.

- 1) Provide documentation of pull out resistance values using manufacturer's approved procedures.

3. Ensure general rigidity and proper slope for drainage.
4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units more than 1/16 inch (1.6 mm) out of plane relative to adjoining deck.

B. Unacceptable panels should be brought to the attention of the General Contractor and Project Owner's Representative and must be corrected prior to installation of roofing system.

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

#### 3.2 PREPARATION

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

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

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

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

#### 3.3 RE-ROOF PREPARATION (GYM LOCATION)

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

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1. Remove an area no larger than can be re-roofed in one day.
- B. Tear out all base flashings, counterflashings, pitch pans, pipe flashings, vents and like components necessary for application of new membrane.
- C. Remove abandoned equipment curbs, skylights, smoke hatches, and penetrations.
  1. Install decking to match existing as directed by Owner's Representative.
- D. Raise (disconnect by licensed craftsmen, if necessary) all HVAC units and other equipment supported by curbs to conform with the following:
  1. Modify curbs as required to provide a minimum 8" base flashing height measured from the surface of the new membrane to the top of the flashing membrane.
  2. Secure of flashing and install new metal counterflashing prior to re-installation of unit.
  3. Perimeter nailers must be elevated to match elevation of new roof insulation.
- E. Immediately remove all debris from roof surface. Demolished roof system may not be stored on the roof surface.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 RE-COVER PREPARATION (ALL LOCATIONS EXCEPT GYM)

- A. Prepare existing roof according to roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer, and requirements in this Section.
- B. Tear out all base flashings, counterflashings, pitch pans, pipe flashings, vents and like components necessary for application of new membrane.
- C. **Disable existing roof membrane per manufacturer's written instruction.**
- D. Remove and replace wet, deteriorated or damaged roof insulation and decking as identified in moisture survey.
- E. Remove abandoned equipment curbs, skylights, smoke hatches, and penetrations. Install decking to match existing as directed by Owner's Representative.
- F. Raise, (disconnect by licensed craftsmen, if necessary) all HVAC units and other equipment supported by curbs to conform with the following:
  1. Modify curbs as required to provide a minimum 8 inch base flashing height measured from the surface of the new membrane to the top of the flashing membrane.
  2. Secure top of flashing and install new metal counterflashing prior to re-installation of unit.
  3. Perimeter nailers must be elevated to match elevation of new roof insulation.
- G. Immediately remove all debris from roof surface, including existing rock ballast and moss. Demolished roof system may not be stored on the roof surface.
- H. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.5 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
  - 1. Fasten substrate board to wood deck to resist uplift pressure at corners, perimeter, and field of roof per roofing system manufacturer's written instructions
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.6 BASE-SHEET INSTALLATION

- A. Install one lapped base sheet course and mechanically fasten to substrate per roofing system manufacturer's written instructions.
  - 1. Enhance fastening rate in perimeter and corner zones per code requirements, wind uplift system approvals or manufacturer's guarantee requirements, whichever is more stringent.
- B. Comply with roofing system manufacturer's written instructions for installing roof insulation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.7 VAPOR-RETARDER INSTALLATION

- A. Install 2 glass-fiber felt plies lapping each sheet 19 inches (483 mm) over preceding sheet. Embed each sheet in fluid-applied asphaltic or bituminous material per manufacturer's written instructions.
- B. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.
  - 1. Repair tears and voids in laps and lapped seams not completely sealed.
- C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.8 INSULATION INSTALLATION

- A. Coordinate installation of roof system components so insulation and cover board is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system manufacturer's written instructions for installation of roof insulation and cover board.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.

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- D. Install insulation boards with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer's written instructions. Fill gaps exceeding 1/4 inch (6 mm) with like material.
- E. Install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
- F. Trim surface of insulation boards where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- G. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- H. Preliminarily Fastened Insulation: Install insulation with fasteners at rate required by roofing system manufacturer or applicable authority, whichever is more stringent.
  - 1. Fasten top layer to resist uplift pressure at corners, perimeter, and field of roof.
- I. Adhered Insulation: Adhere each layer of insulation to substrate as follows:
  - 1. Install each layer in a two-part urethane adhesive according to roofing system manufacturer's instruction.
  - 2. Install each layer to resist uplift pressure at corners, perimeter, and field of roof.
- J. Loose Laid Insulation with Top Insulation Layer Mechanically Fastened: Loose lay insulation with staggered joints and secure top layer of insulation to deck using mechanical fasteners designed and sized for fastening specified board-type to deck type.
  - 1. Fasten top layer to resist uplift pressure at corners, perimeter, and field of roof.
- K. Mechanically Fastened with Subsequent Layers Adhered Insulation: Secure first layer of insulation to deck using mechanical fasteners designed and sized for fastening specified board-type to deck type.
  - 1. Fasten first layer to resist uplift pressure at corners, perimeter, and field of roof.
  - 2. Install subsequent layers in a two-part urethane adhesive according to roofing system manufacturer's instruction.
  - 3. Install each layer to resist uplift pressure at corners, perimeter, and field of roof.
- L. Proceed with installation only after unsatisfactory conditions have been corrected.

3.9 COVER BOARD INSTALLATION

- A. Coordinate installing membrane roofing system components so cover board is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system manufacturer's written instructions for installing roof cover board.
- C. Install cover board with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer's written instructions. Fill gaps exceeding 1/4 inch (6 mm) with cover board.

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1. Cut and fit cover board within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- D. Trim surface of cover board where necessary at roof drains so completed surface is flush and does not restrict flow of water.
  1. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- E. Adhered Cover Board: Adhere cover board to substrate as follows:
  1. Install in a two-part urethane adhesive according to roofing system manufacturer's instruction.
  2. Install to resist uplift pressure at corners, perimeter, and field of roof.
- F. Mechanically Fastened Cover Board: Install cover board and secure to deck using mechanical fasteners designed and sized for fastening specified cover board to deck type.
  1. Fasten to resist uplift pressure at corners, perimeter, and field of roof.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.10 ROOFING MEMBRANE INSTALLATION, GENERAL

- A. Install roofing membrane in accordance with roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer and requirements in this Section.
- B. Where roof slope exceeds 1/2 inch per 12 inches (1:24), contact the membrane manufacturer for installation instructions regarding installation direction and backnailing.
- C. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.
- D. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is imminent.
  1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt with joints and edges sealed.
  2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
  3. Remove and discard temporary seals before beginning work on adjoining roofing.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.11 ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing in accordance with membrane roofing system manufacturer's written instructions.

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1. Unroll roofing membrane and allow to relax before installing.
  2. Install sheet in accordance with roofing system manufacturer's written instructions.
- B. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- C. Bonding Adhesive: Apply water-based bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- D. Mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- E. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- F. Field Fabricated Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.
- G. Tape to Tape Installation: Align membrane for appropriate overlap, remove release liners and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation.
- H. Tape to Standard Sheet Installation: Align membrane for appropriate overlap, clean and prime non-taped face of splice area, remove release liners and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation.
- I. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
- J. Install roofing membrane and auxiliary materials to tie in to existing roofing.
- K. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.12 BASE FLASHING INSTALLATION
- A. Install sheet flashings and preformed flashing accessories and adhere to substrates in accordance with membrane roofing system manufacturer's written instructions.
- B. Apply solvent-based bonding adhesive at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Apply two-sided water-based bonding adhesive at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- D. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- E. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive.

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- F. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.13 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.
- B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions in locations indicated, to form walkways. Leave 3 inches (75 mm) of space between adjacent roof pavers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's Registered Roof Observer (RRO) to inspect roofing installation on completion and submit report to Architect.
  - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- C. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.15 PROTECTION AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075323



SECTION 077221

ROOF HATCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Provide factory-fabricated roof hatches for ladder access.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data.
- B. Shop Drawings: Submit shop drawings including profiles, accessories, location, adjacent construction interface, and dimensions.
- C. Warranty: Submit executed copy of manufacturer's standard warranty.

1.3 QUALITY ASSURANCE

- A. Manufacturer: A minimum of 5 years experience manufacturing similar products.
- B. Installer: A minimum of 2 years experience installing similar products.
- C. Manufacturer's Quality System: Registered to ISO 9001:2008 Quality Standards including in-house engineering for product design activities.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-ventilated area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

1.5 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design Manufacturer: Type E Roof Hatch by The BILCO Company, P.O. Box 1203, New Haven, CT 06505, 1-800-366-6530, Fax: 1-203-535-1582, Web: [www.bilco.com](http://www.bilco.com).

2.2 ROOF HATCH

- A. Furnish and install where indicated on plans metal roof hatch Type E, 36" x 36". The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer.
- B. Performance characteristics:
  - 1. Cover shall be reinforced to support a minimum live load of 40 psf (195kg/m<sup>2</sup>) with a maximum deflection of 1/150th of the span and a 140 psf (684 kg/m<sup>2</sup>) wind.
  - 2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
  - 3. Operation of the cover shall not be affected by temperature.
  - 4. Entire hatch shall be weather tight with fully welded corner joints on cover and curb.
- C. Cover: Shall be select: 14 gauge (1.9mm) paint bond G-90 galvanized steel with a 3" (76mm) beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
- D. Cover insulation: Shall be fiberglass of 1" (25mm) thickness, fully covered and protected by a metal liner 22 gauge (.8mm) paint bond G-90 galvanized steel.
- E. Curb: Shall be 12" (305mm) in height and of 14 gauge (1.9mm) paint bond G-90 galvanized steel or. The curb shall be formed with a 3-1/2" (89mm) flange with 7/16" (11.1mm) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip<sup>®</sup> flashing system, including stamped tabs, 6" (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.
- F. Curb insulation: Shall be rigid, high-density fiberboard of 1" (25mm) thickness on outside of curb.
- G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe [for aluminum construction: welded to the curb assembly; for steel construction: through bolted to the curb assembly].
- H. Hardware
  - 1. Heavy pintle hinges shall be provided
  - 2. Cover shall be equipped with a spring latch with interior and exterior turn handles
  - 3. Roof hatch shall be equipped with interior and exterior padlock hasps.
  - 4. The latch strike shall be a stamped component bolted to the curb assembly.
  - 5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle to permit easy release for closing.
  - 6. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed.
  - 7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

- I. Finishes: Factory finish shall be alkyd based red oxide primed steel.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.
  - 1. Test units for proper function and adjust until proper operation is achieved.
  - 2. Repair finishes damaged during installation.
  - 3. Restore finishes so no evidence remains of corrective work.

#### 3.3 ADJUSTING AND CLEANING

- A. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

END OF SECTION

SECTION 077222

ROOF HATCH RAIL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Provide factory-fabricated fixed hatch railing system.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data.
- B. Shop Drawings: Submit shop drawings including profiles, accessories, location, adjacent construction interface, and dimensions.
- C. Warranty: Submit executed copy of manufacturer's standard warranty.

1.3 QUALITY ASSURANCE

- A. Manufacturer: A minimum of 5 years experience manufacturing similar products.
- B. Installer: A minimum of 2 years experience installing similar products.
- C. Manufacturer's Quality System: Registered to ISO 9001:2008 Quality Standards including in-house engineering for product design activities.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-ventilated area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

1.5 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design Manufacturer: Type Bil-Guard® 2.0 Roof Hatch Railing System by The BILCO Company, P.O. Box 1203, New Haven, CT 06505, 800-366-6530, Fax: 1-203-535-1582, Web: [www.bilco.com](http://www.bilco.com).

2.2 HATCH RAIL SYSTEM

- A. Furnish and install where indicated on plans hatch rail system. The hatch rail system shall be field assembled and installed per the manufacturer's instructions.
- B. Performance characteristics:
  - 1. High visibility safety yellow powder coat paint finish (*other colors available as a special order*).
  - 2. Hatch rail system shall attach to the capflashing of the roof hatch and shall not penetrate any roofing material.
  - 3. Hatch rail system shall satisfy the requirements of OSHA 29 CFR 1910.29 and shall meet OSHA strength requirements with a factor of safety of two.
  - 4. Corrosion resistant construction with a five-year warranty.
  - 5. Hinged gate shall ensure continuous barrier around the roof hatch.
  - 6. Self-closing gate hinge and positive latching system provided with hatch rail system.
- C. Posts and Rails: 1-1/4" (32mm) 6061 T6 schedule 40 aluminum pipe
- D. Hardware: Mounting brackets shall be 3/8" (9mm) thick extruded aluminum. Pivoting post guides with compression fittings and latching mechanism shall be cast aluminum. Self-closing hinges and all fasteners shall be type 316 stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.
  - 1. Test units for proper function and adjust until proper operation is achieved.
  - 2. Repair finishes damaged during installation.
  - 3. Restore finishes so no evidence remains of corrective work.

3.3 ADJUSTING AND CLEANING

- A. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

END OF SECTION

SECTION00 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:

1. Interior gypsum board.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PART 2 - PRODUCTS

2.1 RECYCLED CONTENT OF GYPSUM PANELS

2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Gypsum Co.
    - b. G-P Gypsum.
    - c. National Gypsum Company.
    - d. USG Corporation.
- B. Regular Type:
1. Thickness: Match existing.

2. Long Edges: Tapered
- C. Type X:
  1. Thickness: Match existing
  2. Long Edges: Tapered
- D. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
  1. Thickness: Match existing
  2. Long Edges: Tapered
- E. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
  1. Core: Match existing thickness, Type X.
  2. Long Edges: Tapered.

## 2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc
  2. Shapes:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - d. L-Bead: L-shaped; exposed long flange receives joint compound.
    - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - f. Expansion (control) joint.
    - g. Curved-Edge Cornerbead: With notched or flexible flanges.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
  1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Fry Reglet Corp.
    - b. Gordon, Inc.
    - c. Pittcon Industries.
  2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
  3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

## 2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.

- B. Joint Tape:
  - 1. Interior Gypsum Wallboard: Paper.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints, damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
  - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.

## 2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
  - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

## PART 3 - EXECUTION

### 3.1 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.



- D. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members, or provide control joints to counteract wood shrinkage.

### 3.2 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners, unless otherwise indicated.
  - 2. LC-Bead: Use at exposed panel edges.

### 3.3 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for acoustical tile.
  - 3. Level 3: At panel surfaces that will not exposed to view (i.e., storage and utility areas).
  - 4. 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 09 Sections.

### 3.4 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns. Texture finish shall match existing.

- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

### 3.5 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Vinyl composition floor tile.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: Full-size units of each color and pattern of floor tile required.
- C. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive floor tile.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE (VCT)

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:

1. Armstrong World Industries, Inc.; 'Standard Excelon'
  2. Azrock; 'Cortina Colors and Classics'.
  3. Mannington Mills, Inc.; 'Essentials'.
- B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.
- C. Wearing Surface: Match existing.
- D. Thickness: 0.125 inch (3.2 mm)
- E. Size: 12 by 12 inches (305 by 305 mm).
- F. Colors and Patterns: As selected by Architect from full range of industry colors.

## 2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
    - b. Rubber Floor Adhesives: Not more than 60 g/L.
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
  4. Moisture Testing: Perform tests recommended by floor covering manufacturer. Proceed with installation only after substrates pass testing.

- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are same temperature as space where they are to be installed.
  - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

### 3.2 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- C. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- E. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish. Use wax product specified by BSD Custodial Services. Apply six coats in corridors and three coats in classrooms at manufacturer's recommended rates unless directed otherwise by BSD Representative.
- C. Cover floor tile until Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes modular carpet tile.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: For each color and texture required.
  - 1. Carpet Tile: Full-size Sample.
  - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- C. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.6 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within lifetime of product. Warranty shall include stain resistance.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Products: Subject to compliance with requirements, provide carpet tile and installation accessories from one of the following or approved equal:
  - 1. Mohawk
  - 2. Lees
  - 3. Mannington
  - 4. Interface
    - a. Color and Pattern: Provide manufacturer's closest matching samples to existing for Architect's and Owner's Representative's approval.
- B. Fiber Content: 100 percent nylon 6, 6
- C. Pile Characteristic: Cut-and-loop *pile*.
- D. Density: 30oz per square yard
- E. Finished Pile Height: 5/32"
- F. Stitches: 9.33 per inch
- G. Gauge: 1/10"
- H. Total Thickness: .280"
- I. Tufted Pile Weight: 30 oz per square yard.
- J. Total Weight: 170.5 ounces per square yard.

- K. Primary Backing/Backcoating: Manufacturer's standard reinforced composite materials.
- L. Secondary Backing: Manufacturer's standard material.
- M. Size: 24 by 24 inches
- N. Applied Soil-Resistance Treatment: Manufacturer's standard material
- O. Antimicrobial Treatment: Manufacturer's standard material

## 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- D. Install pattern parallel to walls and borders.

END OF SECTION



## PART 1 - GENERAL

### 1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Clay masonry.
  - 2. Galvanized metal.
  - 3. Gypsum board.

### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.
- C. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

### 1.3 QUALITY ASSURANCE

- A. MPI Standards:
  - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
  - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

### 1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional 1 gal. (3.8 L) of each material and color applied.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- 1. Provide paint products by one of the following paint manufacturers:
  - a. Rodda Paint
  - b. Miller Paint
  - c. Sherwin Williams
  - d. Kelly Moore

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: Match existing.

2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

2.4 LATEX PAINTS

A. Interior Latex (Satin): MPI #43 (Gloss Level 4).

EXECUTION

2.5 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Masonry (Clay and CMU): 12 percent.
  2. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

2.6 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

INTERIOR PAINTING  
SECTION 099123

- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Mechanical and Electrical Work: Paint items exposed to view as where indicated in drawings.
- E. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION

# **LIMITED SUPPLEMENTAL ASBESTOS AND LEAD PAINT SURVEY REPORT**

## **Cedar Mill Elementary School**

**10265 NW Cornell Road  
Portland, OR 97229**

Prepared for:

### **Beaverton School District**

**16550 SW Merlo Road  
Beaverton, OR 97006**

**Inspection Dates:** November 28, 2018 & December 7, 2018

**Report Prepared:** December 19, 2018

Prepared By:



**4105 SE International Way, Suite 505  
Milwaukie, OR 97222  
503.387.3251**

TRC Project Number: 321417

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### Appendices

- Appendix A – Figures
- Appendix B – Laboratory Analytical Data Sheets
- Appendix C – Inspector Certification(s)

## **EXECUTIVE SUMMARY**

TRC Environmental Corporation (TRC) was contracted by the Beaverton School District to conduct a supplemental asbestos and lead paint survey, including collection of bulk asbestos samples, laboratory analysis, and preparation of a report for Cedar Mill Elementary School located at 10265 NW Cornell Road in Portland, Oregon 97229. Mr. Matt Cuda and Mr. Jason Stone, AHERA accredited building inspectors and lead risk assessor, performed the survey on November 28<sup>th</sup>, 2018 and December 7<sup>th</sup>, 2018. The survey activities included the review of prior sampling documentation and reports provided by the District, inspection and assessment of accessible suspect building materials, collection of bulk samples of suspect asbestos containing building materials that had previously not be sampled, and submission of bulk samples for laboratory analysis.

### **ASBESTOS MATERIAL SUMMARY**

Suspect asbestos containing building materials were sampled and submitted under the chain-of-custody (COC) protocol to an accredited laboratory for polarized light microscopy (PLM) bulk sample analysis. Inspection, sampling and analytical procedures were performed in general accordance with the U.S. Environmental Protection Agency's (EPA's) National Emission Standards for Hazardous Air Pollutants (NESHAP) EPA 40 CFR 61 Subpart M, the EPA Asbestos Hazard Emergency Response Act (AHERA) 40 CFR Part 763, and Federal Occupational Safety and Health Administration (OSHA) 29 CFR 1926.1101 guidelines.

The following materials sampled during this investigation and prior investigations were identified as asbestos containing materials:

- Pipe Run Insulation (Steam Lines)
- Pipe Fitting Insulation (Steam Lines)
- Joint Compound Associated with Gypsum Board Walls and Ceilings.
- Cement Asbestos Board/Chalkboards (Previously Sampled)
- Cove Base & Mastic (Reportedly Abated)
- Countertop and Mastic (Reportedly Abated)
- Hard Fittings (Reportedly Abated)
- Vinyl Floor Tile and Associated Mastic (Previously Sampled)

TRC inspected wall/ceiling cavities to locate any potential suspect pipe insulation. It appears that all the pipe insulation and fittings associated with the steam piping are asbestos containing; however it appears all the piping found to be associated with the domestic water pipes appears to have been replaced and during this assessment were found either to be fiberglass insulated or uninsulated. It should be noted however that the potential still exists for hidden pipe insulation materials to exist within wall/ceiling/floor cavities and HVAC units that were not accessible.

Additionally, any materials uncovered during renovation activities that are not addressed in this inspection report or prior reports for the building are considered presumed asbestos containing materials and must be sampled by an accredited asbestos inspector prior to disturbance, or they must be treated as asbestos containing.

### **LEAD PAINT/GLAZING MATERIAL SUMMARY**

Lead-based paint (LBP) is defined by the United States Department of House and Urban Development (HUD) as any paint, varnish, stain, or other applied coating that has one mg/cm<sup>2</sup> or more of lead or 0.5% by weight (5,000 micrograms per gram [µg/g] or 5,000 parts of lead per million [ppm]). The United States' Consumer Product Safety Commission (CPSC) banned lead paint in 1977 in residential properties and public buildings (16 Code of Federal Regulations 1303). According the Oregon Occupational Safety and Health Division's (OR OSHA) Program Directive, Lead: Exposure in Construction, "For all occupational exposure to lead occurring in the course of construction work, the standard (1926.62) does not specify a minimum amount or concentration of lead that triggers a determination that lead is present and the potential for occupational exposure exists. Therefore any paint containing less than one (1) mg/cm<sup>2</sup>, but greater than the laboratory or XRF detection limit is considered to be a lead-containing paint.

X-Ray Fluorescence (XRF) of painted/glazed coatings was performed using an EPA/HUD required XRF Cadmium 109 sourced hand-held analyzer. TRC uses a ThermoScientific Niton XLP 300, serial number 101954, registered in the State of Oregon.

Sixty (60) of the eighty-one (81) XRF readings taken in conjunction with this survey were detected to have concentrations of lead. However, only nine (9) of the readings were found to have concentrations of lead that classify them as lead based paints/glazing.

The following paints/glazings were found to be lead-based:

- White Wood wall in the Gym
- White Wood Column in the Gym
- Light Blue Window Casing in the Book Storage Room
- Light Blue Gypsum/ Plaster Walls in Classroom A112
- Beige Gypsum/Plaster within A Hallway
- Beige Ceramic Tile within the Boy's Restroom

Based on applicable federal and state regulations, all identified and/or assumed lead-paints/glazing must be handled and disposed of by trained personnel. In general, demolition contractors are trained to remove, handle and dispose of lead paints/glazing.

## INTRODUCTION

A supplemental asbestos and lead paint survey was conducted by TRC at Cedar Mill Elementary School, located at 10265 NW Cornell Road in Portland, Oregon. It was reported by the client that this limited hazardous materials survey is being conducted in conjunction with their HVAC and re-roof renovation project. The survey activities were performed on November 28<sup>th</sup>, 2018 and December 7<sup>th</sup>, 2018, and included the review of prior sampling documentation and reports as well as the inspection, assessment and bulk sampling of suspect asbestos containing building materials that had not previously been sampled. Sample locations are presented on the Sample Location Diagrams in Appendix A.

Mr. Matt Cuda and Mr. Jason Stone, AHERA accredited building inspectors and lead risk assessor, conducted the asbestos survey inspection and sampling activities. Copies of training certificates and state licenses (where applicable) are presented in Appendix C, Inspector Certifications.

## BACKGROUND

### Asbestos Containing Materials

The United States Environmental Protection Agency (EPA) define an asbestos-containing material (ACM) as any material containing more than one percent (>1.0%) asbestos by weight. In addition, ACMs are designated as:

Friable asbestos - material which can be crumbled, pulverized or reduced to powder by hand pressure, a.k.a. Regulated Asbestos Containing Materials (RACM).

Category I Non-friable - includes resilient floor coverings, asphalt roofing products, gaskets and packing.

Category II Non-friable - any non-friable ACM that is not in Category I (i.e. Asbestos-cement (Transite) siding or roofing material).

### OSHA Regulated Materials

The Occupational Safety and Health Administration (OSHA) regulates all materials containing any detectable level of asbestos by weight, including those materials containing 1.0% or less.

### Asbestos Sampling and Analytical Procedures

Representative bulk samples of suspect asbestos-containing building materials were randomly collected from the interior of the building. Homogenous material determination was based on the following criteria:

- Similar physical characteristics (same color and texture, etc.),
- Application (sprayed or trowel-on, assembly into a system, etc.),
- Material function (thermal insulation, floor tile, wallboard system, etc.).

The bulk samples were collected, labeled, and shipped to the certified analytical laboratory under proper COC documentation, and condition and approximate quantity assessments were performed by the accredited inspector during the inspection. Laboratory services were provided by EMC Labs, Inc., in Phoenix, Arizona, a National Voluntary Laboratory Accreditation Program (NVLAP code #101424-0).



Bulk samples were analyzed by PLM utilizing the EPA's Test Methods: Methods for the Determination of Asbestos in Bulk Building Materials (EPA 600/R-93/116, July 1993) and the McCrone Research Institute's The Asbestos Particle Atlas as method references.

Analysis by PLM was performed by visual observation of the bulk sample and slides prepared of the bulk sample for microscopic examination and identification. The samples were analyzed for asbestos (Chrysotile, Amosite, Crocidolite, Anthophyllite, and Actinolite/Tremolite), fibrous non-asbestos constituents (mineral wool, cellulose, etc.) and non-fibrous constituents. Using a stereoscope, the microscopist visually estimates the relative amounts of each constituent by determining the estimated area of the asbestos compared with the area estimate of the total sample.

#### Lead-based and Lead-containing Paints

Lead-based paint (LBP) is defined by the United States Department of Housing and Urban Development (HUD) as any paint, varnish, stain, or other applied coating that has one (1) mg/cm<sup>2</sup> or more of lead or 0.5% by weight (5,000 micrograms per gram [µg/g] or 5,000 parts of lead per million [ppm]).

According the Occupational Safety and Health Division's (OSHA) Program Directive, Lead: Exposure in Construction, "For all occupational exposure to lead occurring in the course of construction work, the standard (1926.62) does not specify a minimum amount or concentration of lead that triggers a determination that lead is present and the potential for occupational exposure exists. Therefore any paint containing less than one (1) mg/cm<sup>2</sup>, but greater than the laboratory detection limit is considered to be a lead-containing paint.

X-Ray Fluorescence (XRF) analysis of painted coatings was performed using an EPA/HUD required XRF Cadmium 109 sourced hand-held analyzer. TRC uses a ThermoScientific Niton XLP 300, serial number 101954, registered in the State of Oregon. Additionally, TRC collected paint chip samples for laboratory analysis of any loose and flakey paint observed during this survey.

## ASBESTOS FINDINGS & RECOMMENDATIONS

The following table presents the location and quantities of each suspect building material identified and sampled during this survey as well as all applicable analytical results:

Sample No.	Material	Sample Location	Asbestos Content	Approximate Quantity
CMES-01A CMES-01B CMES-01C	Pipe Run Insulation (Steam Lines)	Throughout	10% Amosite 5% Chrysotile	800 LF
CMES-02A CMES-02B CMES-02C	Pipe Fitting Insulation (Steam Lines)	Throughout	60% Chrysotile	240
CMES-03A	HVAC Vibration Damper Cloth (Gym Attic)	Gym Attic	ND	N/A
CMES-04A CMES-04B CMES-04C	1' x 1' Ceiling Tile, Even Holes and Brown Glue	Lower Gym Storage Hallway, Staff Lounge	Tile – ND Glue – ND	N/A

ND = Non-detect

SF = Square feet

LF = Linear Feet

N/A = Not Applicable

Sample No.	Material	Sample Location	Asbestos Content	Approximate Quantity
CMES-05A CMES-05B CMES-05C	1' x 1' Ceiling Tile, Random Holes and Brown Glue	Throughout	Tile – ND Glue – ND	N/A
CMES-06A CMES-06B CMES-06C CMES-06D CMES-06E CMES-06F CMES-06G	Gypsum Board and Joint Compound / Plaster (Wall & Ceiling Systems)	Throughout	G.B. – ND J.C. – 5% Chrysotile	80,000 SF
CMES-07A CMES-07B CMES-07C	Carpet Glue	Throughout	ND	N/A
CMES-08A CMES-08B CMES-08C	12" x 12" White Floor Tile with Gray Streaks and Associated Glue	Throughout	Tile – ND Glue – ND	N/A
CMES-09A CMES-09B CMES-09C	Light Yellow Sheet Vinyl Flooring	Throughout	S.V. – ND Glue – ND	N/A
CMES-10A CMES-10B	12" x 12" Cream Floor Tile and Associated Glue	Room A114	Tile – ND Glue – ND	N/A
CMES-11A CMES-11B CMES-11C	Built-up Roofing (Gym)	Roof	ND	N/A
CMES-12A CMES-12B	Built-up Roofing (Core)	Roof	ND	N/A
CMES-13A CMES-13B	Built-up Roofing (Core)	Roof	ND	N/A
CMES-14A CMES-14B	Built-up Roofing (Core)	Roof	ND	N/A
CMES-15A CMES-15B	Built-up Roofing (Core)	Roof	ND	N/A
CMES-16A CMES-16B	Built-up Roofing (Core)	Roof	ND	N/A
CMES-17A CMES-17B	Built-up Roofing (Core)	Roof	ND	N/A
CMES-18A CMES-18B CMES-18C	Roof Mastic	Roof	ND	N/A

ND = Non-detect

SF = Square feet

LF = Linear Feet

N/A = Not Applicable

### Asbestos Containing Materials (ACMs)

Asbestos was detected in the following materials sampled during this and prior investigations:

Material	Approximate Location(s)	Approximate Quantity
Pipe Run Insulation (Steam Lines)	Throughout	800 LF
Pipe Fitting Insulation (Steam Lines)	Throughout	240

Material	Approximate Location(s)	Approximate Quantity
Gypsum Board and Joint Compound / Plaster	Throughout	80,000 SF
Cement Asbestos Board/ Chalkboard	Level 1 / A104	Unknown – Prior Report
Cove Base and Mastic (Abated 2012)	Level 1 / A114	Unknown – Prior Report
Counter Top and Mastic (Abated 2008)	Level 1/ A116	Unknown – Prior Report
Hard Fittings (Abated 2008)	Lower Level / Cafeteria	Unknown – Prior Report
Floor Tile and Mastic - 9" x 9"	Lower Level / Gym Office Hallway	Unknown – Prior Report

Non-Detect Materials (ND)

Asbestos was not detected in the following materials sampled during this investigation:

Material	Location
Built-up Roofing	Throughout
Roofing Mastic	Throughout
HVAC Vibration Damper Cloth (Gym Attic)	Gym Attic
1' x 1' Ceiling Tile, Even Holes and Brown Glue	Lower Gym Storage Hallway, Staff Lounge
1' x 1' Ceiling Tile, Random Holes and Brown Glue	Throughout
Carpet Glue	Throughout
12" x 12" White Floor Tile with Gray Streaks and Associated Glue	Throughout
Light Yellow Sheet Vinyl Flooring	Throughout
12" x 12" Cream Floor Tile and Associated Glue	Room A114
Material Debris	Attic/ Library
Glued-on Ceiling Tiles	Level 1 / A Hall, A106, Main Corridor, Main Hall, Lower Level / Staff
Joint Compound	Level 1/ A100, A110
Mastic behind Sink Backsplash	Level 1 / A104
Wall and Ceiling Plaster	Level 1/ A104, A108, A122
Countertop and Mastic	Level 1/ A106, A108
Ceramic Tile/Grout	Level 1 Restroom Boy's 2
Cove Base and Mastic, Brown	Lower Level / Cafeteria
Ceiling Tile	Lower Level / Cafeteria, Kitchen

Due to the Site being an occupied building at the time of the inspection and sampling, a full destructive investigation for concealed materials was not performed. Hidden building materials (e.g., old floor mastic patches hidden under carpeting, chalkboard mastic, mirror mastic, wood paneling mastic, etc.), other than those discussed in this report, could be uncovered when removing building finishes during renovation activities. Any materials encountered during the renovation activities that are not identified in this report, should either be presumed to be asbestos containing and handled as ACM or be sampled by an accredited asbestos inspector to determine if it contains asbestos.

## LEAD PAINT FINDINGS & RECOMMENDATIONS

The following table presents the suspect paints identified and analyzed with X-Ray Fluorescence during this survey as well as all applicable analytical results:

No.	Component	Substrate	Side	Color	Floor	Room	Sub Room	Results	mg/cm <sup>2</sup>
1	ShutterCal								2.86
2	CALIBRATE		UPPER	RED				Positive	1
3	CALIBRATE		UPPER	RED				Positive	1.1
4	CALIBRATE		UPPER	RED				Positive	1
5	CALIBRATE		LOWER	RED				Positive	1.1
6	UPPER WALL	WOOD	A	WHITE	1st	GYM		LBP	1.2
7	LOWER WALL	WOOD	A	BEIGE	1st	GYM		LCP	0.27
8	DOOR CASING	WOOD	A	D. BLUE	1st	GYM		LCP	0.02
9	DOOR CASING	METAL	A	D. BLUE	1st	GYM		LCP	0.02
10	DOOR	METAL	A	L. BLUE	1st	GYM		Negative	0
11	COLUMN	WOOD	A	WHITE	1st	GYM		LBP	1.4
12	UPPER WALL	WOOD	C	WHITE	1st	GYM		LBP	1.6
13	LOWER WALL	WOOD	C	BEIGE	1st	GYM		LCP	0.15
14	DOOR CASING	WOOD	C	D. BLUE	1st	GYM		LCP	0.14
15	DOOR	WOOD	C	L. BLUE	1st	GYM		LCP	0.23
16	WALL	WOOD	A	YELLOW	1st	GYM	STAGE	LCP	0.5
17	WALL	WOOD	C	YELLOW	1st	GYM	STAGE	LCP	0.7
18	DOOR CASING	WOOD	C	BLUE	1st	GYM	STAGE	LCP	0.21
19	DOOR	WOOD	C	BLUE	1st	GYM	STAGE	LCP	0.07
20	DOOR	WOOD	C	L. BLUE	1st	GYM	STAGE	LCP	0.28
21	CEILING	WOOD	UPPER	YELLOW	1st	GYM	STAGE	LCP	0.01
22	HANDRAIL	WOOD	D	YELLOW	1st	GYM	STAGE	LCP	0.13
23	WALL	CONCRETE	A	WHITE	1st	GYM	BOOK STORAGE	LCP	0.13
24	WALL	DRYWALL	B	WHITE	1st	GYM	BOOK STORAGE	Negative	0
25	WALL	CONCRETE	C	WHITE	1st	GYM	BOOK STORAGE	Negative	0
26	DOOR CASING	METAL	C	TAN	1st	GYM	BOOK STORAGE	Negative	0
27	WINDOW CASING	WOOD	C	L. BLUE	1st	GYM	BOOK STORAGE	LBP	1
28	WINDOW	WOOD	C	WHITE	1st	GYM	BOOK STORAGE	LCP	0.6
29	TREAD	WOOD	B	RED	1st	GYM	STAIR	LCP	0.21
30	WALL	DRYWALL	A	RED	1st	A108		LCP	0.05
31	WINDOW CASING	WOOD	A	L. BLUE	1st	A108		LCP	0.07
32	HEATER	METAL	A	L. BLUE	1st	A108		LCP	0.26
33	HEATER	DRYWALL	C	WHITE	1st	A108		LCP	0.02
34	WHITEBOARD CASING	WOOD	C	GRAY	1st	A108		Negative	0
35	WALL	DRYWALL	B	L. BLUE	1st	A112		Negative	0
36	WALL	DRYWALL	D	L. BLUE	1st	A112		LBP	4.9
37	WALL	DRYWALL	A	L. BLUE	1st	A112		LBP	2.9
38	WALL	DRYWALL	C	L. BLUE	1st	A112		Negative	0

No.	Component	Substrate	Side	Color	Floor	Room	Sub Room	Results	mg/cm <sup>2</sup>
39	CHALKBOARD CASING	WOOD	D	L. GRAY	1st	A112		Negative	0
40	UPPER WALL	DRYWALL	B	WHITE	1st	A HALL		LCP	0.09
41	LOWER WALL	PLASTER	B	BEIGE	1st	A HALL		Null	0.9
42	LOWER WALL	PLASTER	B	BEIGE	1st	A HALL		Null	1.2
43	LOWER WALL	PLASTER	B	BEIGE	1st	A HALL		Null	1
44	LOWER WALL	PLASTER	B	BEIGE	1st	A HALL		LBP	1.3
45	LOWER WALL	PLASTER	D	BEIGE	1st	A HALL		LBP	1.2
46	UPPER WALL	PLASTER	D	WHITE	1st	A HALL		LCP	0.25
47	WALL	DRYWALL	A	WHITE	1st	BOYS RR		LCP	0.4
48	WALL	DRYWALL	B	WHITE	1st	BOYS RR		LCP	0.5
49	LOWER WALL	CERAMIC	B	BEIGE	1st	BOYS RR		LBP	9.3
50	DOOR CASING	WOOD	B	BLUE	1st	BOYS RR		Negative	0
51	DOOR	WOOD	B	BLUE	1st	BOYS RR		Negative	0
52	SINK	CERAMIC	C	WHITE	1st	BOYS RR		Negative	0
53	WALL	PLASTER	B	BEIGE	1st	A116		LCP	0.05
54	WINDOW CASING	WOOD	B	WHITE	1st	A116		LCP	0.04
55	WALL	PLASTER	C	BEIGE	1st	A116		LCP	0.02
56	WALL	PLASTER	D	BEIGE	1st	A116		LCP	0.05
57	WALL	PLASTER	A	WHITE	1st	A120		LCP	0.05
58	WALL	PLASTER	B	WHITE	1st	A120		LCP	0.05
59	WALL	DRYWALL	C	WHITE	1st	A120		LCP	0.02
60	WALL	PLASTER	D	WHITE	1st	A120		LCP	0.07
61	UPPER WALL	CONCRETE	A	WHITE	BASEMENT	CAFETERIA		LCP	0.04
62	LOWER WALL	CONCRETE	B	WHITE	BASEMENT	CAFETERIA		LCP	0.04
63	LOWER WALL	DRYWALL	C	BLUE	BASEMENT	CAFETERIA		Negative	0
64	UPPER WALL	DRYWALL	C	WHITE	BASEMENT	CAFETERIA		Negative	0
65	UPPER WALL	CONCRETE	D	WHITE	BASEMENT	CAFETERIA		LCP	0.02
66	LOWER WALL	CONCRETE	D	BLUE	BASEMENT	CAFETERIA		LCP	0.03
67	LOWER WALL	PLASTER	A	WHITE	BASEMENT	KITCHEN		LCP	0.7
68	WALL	WOOD	A	BEIGE		KITCHEN		LCP	0.01
69	WINDOW CASING	METAL	A	BROWN		KITCHEN		LCP	0.12
70	DOOR CASING	METAL	A	D. BLUE		KITCHEN		Negative	0
71	DOOR	METAL	A	L. BLUE		KITCHEN		Negative	0
72	UPPER WALL	WOOD	B	BEIGE		KITCHEN		Negative	0
73	LOWER WALL	CONCRETE	B	BEIGE		KITCHEN		Negative	0
74	DOOR CASING	WOOD	B	BROWN		KITCHEN		Negative	0
75	DOOR	METAL	B	BROWN		KITCHEN		LCP	0.19
76	HANDRAIL	METAL	B	BROWN		KITCHEN		Negative	0
77	LATTICE	WOOD	B	BROWN		KITCHEN		Negative	0
78	STAIR	CONCRETE	B	YELLOW		KITCHEN		Null	0.02
79	STAIR	CONCRETE	B	YELLOW		KITCHEN		Negative	0
80	WALL	CONCRETE	C	BEIGE		KITCHEN		LCP	0.01
81	WINDOW CASING	CONCRETE	C	WHITE		KITCHEN		Null	0.01

No.	Component	Substrate	Side	Color	Floor	Room	Sub Room	Results	mg/cm <sup>2</sup>
82	WINDOW CASING	CONCRETE	C	WHITE		KITCHEN		Negative	0
83	BALUSTRADE	METAL	C	BROWN		KITCHEN		LCP	0.01
84	HANDRAIL	METAL	C	BROWN		KITCHEN		LCP	0.01
85	WALL	WOOD	D	BEIGE		KITCHEN		LCP	0.04
86	DOOR CASING	METAL	D	BROWN		KITCHEN		LCP	0.15
87	DOOR	METAL	D	BROWN		KITCHEN		LCP	0.3
88	CALIBRATE		UPPER	RED				Positive	1
89	CALIBRATE		UPPER	RED				Positive	1.1
90	CALIBRATE		UPPER	RED				Positive	1
91	CALIBRATE		LOWER	RED				Null	1
92	CALIBRATE		LOWER	RED				Positive	1.2

LBP = Lead Based Paint      LCP = Lead Containing Paint

Sixty (60) of the eighty-one (81) XRF readings taken in conjunction with this survey were detected to have concentrations of lead. However, only nine (9) of the readings were found to have concentrations of lead that classify them as lead based paints/glazing.

The following paints/glazings were found to be lead-based:

- White Wood wall in the Gym
- White Wood Column in the Gym
- Light Blue Window Casing in the Book Storage Room
- Light Blue Gypsum/ Plaster Walls in Classroom A112
- Beige Gypsum/Plaster within A Hallway
- Beige Ceramic Tile within the Boy's Restroom

Based on applicable federal and state regulations, all identified and/or assumed lead-paints/glazing must be handled and disposed of by trained personnel. In general, demolition contractors are trained to remove, handle and dispose of lead paints/glazing which will not typically generate a large amount of additional cost above and beyond the general demolition activities.

## RECOMMENDATIONS

All identified asbestos containing materials from this investigation and previous investigations must be removed by a licensed asbestos abatement contractor prior to them being impacted by any renovation or demolition activities. Additionally, any materials uncovered during renovation or demolition activities that are not addressed in this inspection report or prior reports for the building are considered presumed asbestos containing materials and must be sampled by an accredited asbestos inspector prior to disturbance, or they must be treated as asbestos containing.

## DISCLAIMER

The content presented in this report is based on data collected during the site inspection and survey, review of pertinent regulations, requirements, guidelines and commonly followed industry standards, and information provided by the Beaverton School District, their clients, agents, and representatives.

The work has been conducted in an objective and unbiased manner and in accordance with generally accepted professional practice for this type of work. TRC believes the data and analysis to be accurate and relevant, but cannot accept responsibility for the accuracy or completeness of available documentation or possible withholding of information by other parties.

This asbestos and lead paint survey report is designed to aid the property owner, architect, construction manager, general contractor, and asbestos abatement contractor in locating potential ACMs. This report is not intended for, and may not be utilized as, a bidding document or as an abatement project specification document.

If you have any questions, or need any further clarification regarding this report, please do not hesitate to contact Mr. Ron Landolt at (503) 407-0734.

Sincerely,

**TRC Environmental Corporation**



Matthew Cuda  
Project Manager



Ron Landolt, CAC  
NW Region BSI Practice Manager

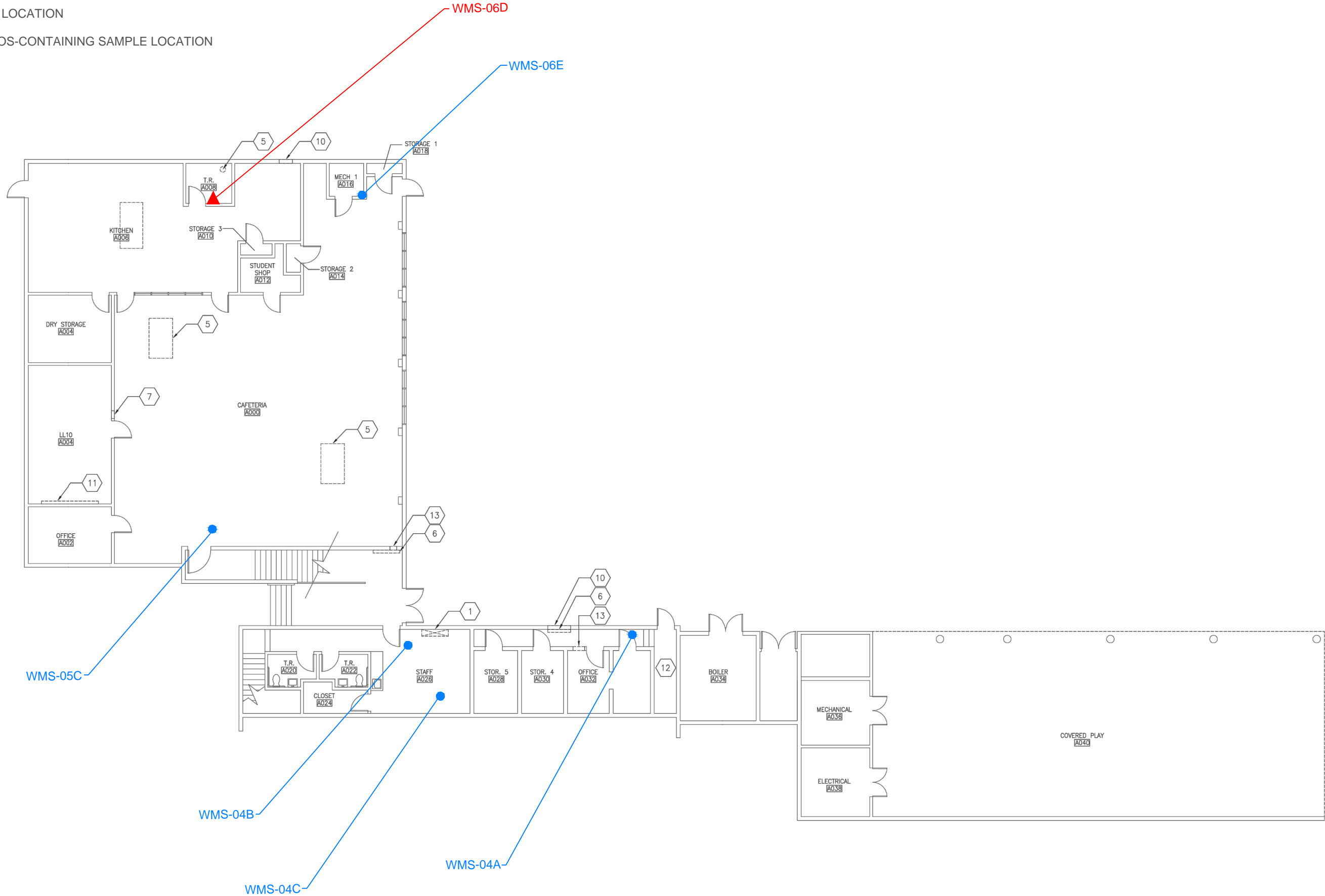
## **Appendix A – Figure(s)**






LEGEND

- SAMPLE LOCATION
- ASBESTOS-CONTAINING SAMPLE LOCATION



		4105 SE International Way Suite 505 Milwaukie, OR 97222 C: 503-407-0734 F: 503-762-6882		SAMPLE LOCATION MAP - LOWER LEVEL		FIGURE NUMBER  1.2
DATE	12/12/18					
PROJECT NO.	Z					
DRAWN BY	SC					
CHECKED BY	MC					
CHECKED BY	RL					

## **Appendix B – Laboratory Analytical Data Sheets**

# EMC LABS, INC.

9830 S. 51st Street, Suite B109, Phoenix, AZ 85044  
Phone: 800-362-3373 or 480-940-5294 - Fax: (480) 893-1726

Laboratory Report

**0212048**

## Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	TRC SOLUTIONS	Job# / P.O. #:	321417
Address:	13370 SE MEADOWPARK DRIVE	Date Received:	11/30/2018
	PORTLAND OR 97086	Date Analyzed:	12/05/2018
Collected:	11/28/2018	Date Reported:	12/05/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	MATT CUDA
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212048-001 CMES-01A	GYM ATTIC	Pipe Run Insulation, White	Yes	Amosite Chrysotile 10% 2%	Carbonates Gypsum Binder/Filler 88%
0212048-002 CMES-01B	TUNNEL ACCESS IN BOY'S RESTRM	LAYER 1 Pipe Run Insulation, White	Yes	Amosite Chrysotile 10% 5%	Carbonates Gypsum Binder/Filler 85%
		LAYER 2 Pipe Run Insulation, Black	Yes	Amosite 2%	Cellulose Fiber 80% Carbonates Gypsum Binder/Filler 18%
0212048-003 CMES-01C	TUNNEL UNDER A110	LAYER 1 Pipe Run Insulation, White	Yes	Amosite Chrysotile 10% 5%	Carbonates Gypsum Binder/Filler 85%
		LAYER 2 Pipe Run Insulation, Black	Yes	Amosite 2%	Cellulose Fiber 80% Carbonates Gypsum Binder/Filler 18%
0212048-004 CMES-02A	GYM ATTIC	LAYER 1 Pipe Run Insulation, White	Yes	Amosite Chrysotile 10% 5%	Carbonates Gypsum Binder/Filler 85%
		LAYER 2 Pipe Run Insulation, Cream	Yes	Amosite 2%	Cellulose Fiber 40% Carbonates Quartz Binder/Filler 58%

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NVLAP#101926-0

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	PORTLAND OR 97086	Date Analyzed:	12/05/2018
Collected:	11/28/2018	Date Reported:	12/05/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	MATT CUDA
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212048-005 CMES-02B	TUNNEL ACCESS IN BOY'S RESTRM	LAYER 1 Pipe Run Insulation, Lt. Gray	Yes	Chrysotile 60%	Cellulose Fiber 5%
					Gypsum Quartz Binder/Filler 35%
		LAYER 2 Pipe Run Insulation, Black	No	None Detected	Cellulose Fiber 90%
					Carbonates Gypsum Binder/Filler 10%
0212048-006 CMES-02C	TUNNEL UNDER A110	Pipe Run Insulation, Lt. Gray	Yes	Chrysotile 60%	Cellulose Fiber 5%
					Gypsum Quartz Binder/Filler 35%
0212048-007 CMES-03A	GYM ATTIC	HVAC Vibration Damper Cloth, Beige	No	None Detected	Cellulose Fiber 95%
					Gypsum Binder/Filler 5%
0212048-008 CMES-04A	LOWER GYM STORAGE HALLWAY	LAYER 1 1x1 Ceiling Tile, White/ Brown	No	None Detected	Cellulose Fiber 85%
					Gypsum Binder/Filler 15%
		LAYER 2 Glue, Brown	No	None Detected	Cellulose Fiber <1%
					Gypsum Quartz Binder/Filler 99%

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**0212048**

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Address:	13370 SE MEADOWPARK DRIVE	Date Received:	11/30/2018
	PORTLAND OR 97086	Date Analyzed:	12/05/2018
Collected:	11/28/2018	Date Reported:	12/05/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	MATT CUDA
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0212048-009 CMES-04B	STAFF LOUNGE	LAYER 1	No	None Detected	Cellulose Fiber	85%
		1x1 Ceiling Tile, White/ Brown			Gypsum Binder/Filler	15%
		LAYER 2			Cellulose Fiber	<1%
		Glue, Brown			Gypsum Quartz Binder/Filler	99%
0212048-010 CMES-04C	STAFF LOUNGE	LAYER 1	No	None Detected	Cellulose Fiber	85%
		1x1 Ceiling Tile, White/ Brown			Gypsum Binder/Filler	15%
		LAYER 2			Cellulose Fiber	2%
		Glue, Brown			Gypsum Quartz Binder/Filler	98%
0212048-011 CMES-05A	MAIN HALLWAY	LAYER 1	No	None Detected	Cellulose Fiber	85%
		1x1 Ceiling Tile, White/ Brown			Gypsum Binder/Filler	15%
		LAYER 2			Cellulose Fiber	1%
		Glue, Brown			Synthetic Fiber Gypsum Quartz Binder/Filler	<1% 98%
0212048-012 CMES-05B	A118	LAYER 1	No	None Detected	Cellulose Fiber	85%
		1x1 Ceiling Tile, White/ Brown			Gypsum Binder/Filler	15%
		LAYER 2			Cellulose Fiber	3%
		Glue, Brown			Gypsum Quartz Binder/Filler	97%

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Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	MATT CUDA
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0212048-013 CMES-05C	CAFETERIA	LAYER 1	No	None Detected	Cellulose Fiber	85%
		1x1 Ceiling Tile, White/ Brown			Gypsum Binder/Filler	15%
		LAYER 2	No	None Detected	Cellulose Fiber	2%
		Glue, Brown			Gypsum Quartz Binder/Filler	98%
0212048-014 CMES-06A	BOY'S RESTRM CUSTODIAL CLOSET	LAYER 1	No	None Detected	Cellulose Fiber	<1%
		Plaster-Scratch Coat, Off White			Gypsum Carbonates Mica Quartz Perlite Binder/Filler	99%
		LAYER 2	No	None Detected	Cellulose Fiber	<1%
		Plaster-Finish Coat, White			Quartz Gypsum Mica Carbonates Perlite Binder/Filler	99%

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Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	MATT CUDA
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0212048-015 CMES-06B	RM A108	LAYER 1	No	None Detected	Cellulose Fiber	<1%
		Plaster-Scratch Coat, Off White			Gypsum Carbonates Mica Quartz Perlite Binder/Filler	99%
		LAYER 2	No	None Detected	Cellulose Fiber	<1%
		Plaster-Finish Coat, White			Quartz Gypsum Mica Carbonates Perlite Binder/Filler	99%
0212048-016 CMES-06C	RM A120	LAYER 1	No	None Detected	Cellulose Fiber	10%
		Gypsum Board, White/ Brown			Fibrous Glass	2%
					Gypsum Mica Quartz Carbonates	88%
		LAYER 2	Yes	Chrysotile	5%	
		Joint Compound, Off White			Carbonates Mica Quartz Binder/Filler	95%
0212048-017 CMES-06D	KITCHEN RESTRM CLOSET	LAYER 1	No	None Detected	Cellulose Fiber	10%
		Gypsum Board, White/ Brown			Fibrous Glass	2%
					Gypsum Mica Quartz Carbonates	88%
		LAYER 2	Yes	Chrysotile	5%	
		Joint Compound, Off White			Carbonates Mica Quartz Binder/Filler	95%



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	PORTLAND OR 97086	Date Analyzed:	12/05/2018
Collected:	11/28/2018	Date Reported:	12/05/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	MATT CUDA
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212048-018 CMES-06E	CAFETERIA HOT WATER CLOSET	LAYER 1 Gypsum Board, White/ Brown	No	None Detected	Cellulose Fiber 10% Fibrous Glass 2% Gypsum Mica Quartz Carbonates 88%
		LAYER 2 Joint Compound, Off White	No	None Detected	Carbonates Mica Quartz Perlite Binder/Filler 100%
0212048-019 CMES-06F	CUSTODIAL CLOSET A126	LAYER 1 Plaster-Scratch Coat, Off White	No	None Detected	Gypsum Carbonates Mica Quartz Perlite Binder/Filler 100%
		LAYER 2 Plaster-Finish Coat, White	No	None Detected	Cellulose Fiber <1% Quartz Gypsum Mica Binder/Filler 99%

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	PORTLAND OR 97086	Date Analyzed:	12/05/2018
Collected:	11/28/2018	Date Reported:	12/05/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	MATT CUDA
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212048-020 CMES-06G	RM A100 CLOSET	LAYER 1 Gypsum Board, White/ Brown	No	None Detected	Cellulose Fiber 12% Gypsum Mica Quartz Carbonates 88%
		LAYER 2 Plaster-Scratch Coat, Off White	No	None Detected	Gypsum Carbonates Mica Quartz Perlite Binder/Filler 100%
		LAYER 3 Plaster-Finish Coat, White	No	None Detected	Cellulose Fiber <1% Quartz Gypsum Mica Carbonates Binder/Filler 99%
0212048-021 CMES-07A	RM A108	Carpet Glue, Yellow	No	None Detected	Cellulose Fiber 5% Carbonates Gypsum Quartz Binder/Filler 95%
0212048-022 CMES-07B	RM A122	Carpet Glue, Yellow/ Red	No	None Detected	Cellulose Fiber 1% Carbonates Quartz Gypsum Binder/Filler 99%
0212048-023 CMES-07C	CUSTODIAL CLOSET A126	Carpet Glue, Yellow	No	None Detected	Cellulose Fiber 5% Carbonates Quartz Gypsum Binder/Filler 95%

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	PORTLAND OR 97086	Date Analyzed:	12/05/2018
Collected:	11/28/2018	Date Reported:	12/05/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	MATT CUDA
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212048-024 CMES-08A	RM A108	LAYER 1 12"x12" Floor Tile, White/ Gray	No	None Detected	Carbonates Quartz Binder/Filler 100%
		LAYER 2 Glue, Yellow	No	None Detected	Cellulose Fiber Carbonates Gypsum Binder/Filler 1%
					99%
0212048-025 CMES-08B	RM A102	LAYER 1 12"x12" Floor Tile, White/ Gray	No	None Detected	Carbonates Quartz Binder/Filler 100%
		LAYER 2 Glue, Yellow	No	None Detected	Cellulose Fiber Synthetic Fiber Carbonates Gypsum Quartz Binder/Filler 1% <1% 98%
0212048-026 CMES-08C	RM A120	LAYER 1 12"x12" Floor Tile, White/ Gray	No	None Detected	Carbonates Quartz Binder/Filler 100%
		LAYER 2 Glue, Yellow	No	None Detected	Cellulose Fiber Carbonates Gypsum Quartz Binder/Filler 2% 98%

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	PORTLAND OR 97086	Date Analyzed:	12/05/2018
Collected:	11/28/2018	Date Reported:	12/05/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	MATT CUDA
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212048-027 CMES-09A	RM A116	LAYER 1 Sheet Vinyl Flooring, Lt. Yellow	No	None Detected	Cellulose Fiber 20% Carbonates Quartz Binder/Filler 80%
		LAYER 2 Mastic, Yellow	No	None Detected	Cellulose Fiber 3% Carbonates Gypsum Quartz Binder/Filler 97%
		LAYER 3 Leveling Compound, Gray	No	None Detected	Cellulose Fiber 5% Carbonates Gypsum Quartz Binder/Filler 95%
0212048-028 CMES-09B	RM A122	LAYER 1 Sheet Vinyl Flooring, Lt. Yellow	No	None Detected	Cellulose Fiber 20% Carbonates Quartz Binder/Filler 80%
		LAYER 2 Mastic, Yellow	No	None Detected	Cellulose Fiber 5% Carbonates Gypsum Quartz Binder/Filler 95%
0212048-029 CMES-09C	CUSTODIAL CLOSET A126	LAYER 1 Sheet Vinyl Flooring, Lt. Yellow	No	None Detected	Cellulose Fiber 20% Carbonates Quartz Binder/Filler 80%
		LAYER 2 Mastic, Yellow	No	None Detected	Cellulose Fiber 5% Carbonates Gypsum Quartz Binder/Filler 95%

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	PORTLAND OR 97086	Date Analyzed:	12/05/2018
Collected:	11/28/2018	Date Reported:	12/05/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	MATT CUDA
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212048-030 CMES-10A	RM A114	12"x12" Floor Tile, Cream	No	None Detected	Carbonates Quartz Binder/Filler 100%
0212048-031 CMES-10B	RM A114	LAYER 1 12"x12" Floor Tile, Cream	No	None Detected	Carbonates Quartz Binder/Filler 100%
		LAYER 2 Glue, Yellow	No	None Detected	Carbonates Quartz Gypsum Binder/Filler 100%



Analyst - Octavio Gavarreteayestas



Signatory - Lab Director - Kurt Kettler

Distinctly stratified, easily separable layers of samples are analyzed as subsamples of the whole and are reported separately for each discernible layer. All analyses are derived from calibrated visual estimate and measured in area percent unless otherwise noted. The report applies to the standards or procedures identified and to the sample(s) tested. The test results are not necessarily indicative or representative of the qualities of the lot from which the sample was taken or of apparently identical or similar products, nor do they represent an ongoing quality assurance program unless so noted. These reports are for the exclusive use of the addressed client and that they will not be reproduced wholly or in part for advertising or other purposes over our signature or in connection with our name without special written permission. The report shall not be reproduced except in full, without written approval by our laboratory. The samples not destroyed in testing are retained a maximum of thirty days. The laboratory measurement of uncertainty for the test method is approximately less than 1 by area percent. Accredited by the National Institute of Standards and Technology, Voluntary Laboratory Accreditation Program for selected test method for asbestos. The accreditation or any reports generated by this laboratory in no way constitutes or implies product certification, approval, or endorsement by the National Institute of Standards and Technology. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government. Polarized Light Microscopy may not be consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials.

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Laboratory Report

**0212546**

## **Bulk Asbestos Analysis by Polarized Light Microscopy**

NVLAP#101926-0

Client:	TRC SOLUTIONS	Job# / P.O. #:	321417
Address:	4105 SE INTERNATIONAL WAY	Date Received:	12/10/2018
	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0212546-001 CMES-11A		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber	1%
					Carbonates	
					Quartz	
					Binder/Filler	99%
		LAYER 2 Roofing, Black	No	None Detected	Cellulose Fiber	8%
					Carbonates	
					Quartz	
					Binder/Filler	92%
		LAYER 3 Roofing, Black	No	None Detected	Synthetic Fiber	15%
					Fibrous Glass	5%
					Carbonates	
					Quartz	
					Binder/Filler	80%
		LAYER 4 Roofing, Brown/ Tan	No	None Detected	Cellulose Fiber	85%
					Carbonates	
					Gypsum	
					Binder/Filler	15%

Please see EMC Labs Sample Number 0212546-019 for Additional Layers

# EMC LABS, INC.

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Laboratory Report

**0212546**

## **Bulk Asbestos Analysis by Polarized Light Microscopy**

NVLAP#101926-0

Client:	TRC SOLUTIONS	Job# / P.O. #:	321417
Address:	4105 SE INTERNATIONAL WAY	Date Received:	12/10/2018
	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents			
0212546-002 CMES-11B		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber	3%		
					Carbonates	97%		
					Quartz			
					Binder/Filler			
		LAYER 2 Roofing, Black	No	None Detected	Cellulose Fiber	5%		
					Fibrous Glass	3%		
					Carbonates	92%		
					Quartz			
	Binder/Filler							
		LAYER 3 Roofing, Black	No	None Detected	Cellulose Fiber	15%		
					Fibrous Glass	3%		
Synthetic Fiber					2%			
Carbonates					80%			
Quartz								
				Binder/Filler	80%			
							Cellulose Fiber	85%
							Carbonates	15%
							Gypsum	
Binder/Filler								

**Please see EMC Labs Sample Number 0212546-020 for Additional Layers**

# EMC LABS, INC.

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	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-003 CMES-11C		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber 1% Carbonates Quartz Binder/Filler 99%
		LAYER 2 Roofing, Black	No	None Detected	Fibrous Glass 5% Cellulose Fiber 2% Synthetic Fiber 1% Carbonates Quartz Binder/Filler 92%
		LAYER 3 Roofing, Black	No	None Detected	Fibrous Glass 5% Cellulose Fiber 2% Synthetic Fiber 1% Carbonates Quartz Binder/Filler 92%
		LAYER 4 Roofing, Brown/ Tan	No	None Detected	Cellulose Fiber 85% Carbonates Gypsum Binder/Filler 15%

**Please see EMC Labs Sample Number 0212546-021 for Additional Layers**



# EMC LABS, INC.

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Laboratory Report

**0212546**

## Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	TRC SOLUTIONS	Job# / P.O. #:	321417
Address:	4105 SE INTERNATIONAL WAY	Date Received:	12/10/2018
	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-004 CMES-12A		LAYER 1 Roofing, Silver	No	None Detected	Fibrous Glass 15% Cellulose Fiber 5% Carbonates Quartz Binder/Filler 80%
		LAYER 2 Roofing, Black	No	None Detected	Fibrous Glass 15% Cellulose Fiber 3% Synthetic Fiber 2% Carbonates Quartz Binder/Filler 80%
		LAYER 3 Roofing, Black	No	None Detected	Cellulose Fiber 15% Fibrous Glass 3% Synthetic Fiber 2% Carbonates Quartz Binder/Filler 80%
		LAYER 4 Roofing, Brown/ Tan	No	None Detected	Cellulose Fiber 85% Carbonates Gypsum Binder/Filler 15%

# EMC LABS, INC.

9830 S. 51st Street, Suite B109, Phoenix, AZ 85044  
Phone: 800-362-3373 or 480-940-5294 - Fax: (480) 893-1726

Laboratory Report

**0212546**

## **Bulk Asbestos Analysis by Polarized Light Microscopy**

NVLAP#101926-0

Client:	TRC SOLUTIONS	Job# / P.O. #:	321417
Address:	4105 SE INTERNATIONAL WAY	Date Received:	12/10/2018
	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-005 CMES-12B		LAYER 1 Roofing, Silver	No	None Detected	Fibrous Glass 15% Synthetic Fiber 5% Carbonates Quartz Binder/Filler 80%
		LAYER 2 Roofing, Black	No	None Detected	Fibrous Glass 15% Cellulose Fiber 3% Synthetic Fiber 2% Carbonates Quartz Binder/Filler 80%
		LAYER 3 Roofing, Black	No	None Detected	Cellulose Fiber 20% Carbonates Quartz Binder/Filler 80%
		LAYER 4 Roofing, Brown/ Tan	No	None Detected	Cellulose Fiber 85% Carbonates Gypsum Binder/Filler 15%

**Please see EMC Labs Sample Number 0212546-022 for Additional Layers**

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## **Bulk Asbestos Analysis by Polarized Light Microscopy**

NVLAP#101926-0

Client:	TRC SOLUTIONS	Job# / P.O. #:	321417
Address:	4105 SE INTERNATIONAL WAY	Date Received:	12/10/2018
	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-006 CMES-13A		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber 1%
					Carbonates
					Quartz
					Binder/Filler 99%
		LAYER 2 Roofing, Gray/ Tan	No	None Detected	Fibrous Glass 5%
					Carbonates
					Quartz
					Binder/Filler 95%
		LAYER 3 Roofing, Black	No	None Detected	Fibrous Glass 10%
					Synthetic Fiber 10%
					Carbonates
					Quartz
					Binder/Filler 80%
		LAYER 4 Roofing, Black	No	None Detected	Cellulose Fiber 15%
					Fibrous Glass 5%
					Carbonates
					Quartz
					Binder/Filler 80%

**Please see EMC Labs Sample Number 0212546-023 for Additional Layers**

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## **Bulk Asbestos Analysis by Polarized Light Microscopy**

NVLAP#101926-0

Client:	TRC SOLUTIONS	Job# / P.O. #:	321417
Address:	4105 SE INTERNATIONAL WAY	Date Received:	12/10/2018
	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-007 CMES-13B		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber 1% Carbonates Quartz Binder/Filler 99%
		LAYER 2 Roofing, Black	No	None Detected	Fibrous Glass 15% Cellulose Fiber 3% Synthetic Fiber 2% Carbonates Quartz Binder/Filler 80%
		LAYER 3 Roofing, Black	No	None Detected	Cellulose Fiber 15% Fibrous Glass 5% Carbonates Quartz Binder/Filler 80%
		LAYER 4 Roofing, Brown/ Tan	No	None Detected	Cellulose Fiber 85% Carbonates Gypsum Binder/Filler 15%

**Please see EMC Labs Sample Number 0212546-024 for Additional Layers**

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## Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	TRC SOLUTIONS	Job# / P.O. #:	321417
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	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-008 CMES-14A		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber <1%
					Carbonates
					Quartz
					Binder/Filler 99%
		LAYER 2 Roofing, Gray/ Tan	No	None Detected	Fibrous Glass 5%
					Carbonates
					Quartz
					Binder/Filler 95%
		LAYER 3 Roofing, Black	No	None Detected	Fibrous Glass 15%
					Synthetic Fiber 5%
					Carbonates
					Quartz
					Binder/Filler 80%
		LAYER 4 Roofing, Black	No	None Detected	Fibrous Glass 15%
					Cellulose Fiber 3%
					Synthetic Fiber 2%
					Carbonates
					Quartz
					Binder/Filler 80%

Please see EMC Labs Sample Number 0212546-025 for Additional Layers

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Laboratory Report

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## Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	TRC SOLUTIONS	Job# / P.O. #:	321417
Address:	4105 SE INTERNATIONAL WAY	Date Received:	12/10/2018
	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-009 CMES-14B		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber <1% Carbonates Quartz Binder/Filler 99%
		LAYER 2 Roofing, Gray/ Tan	No	None Detected	Fibrous Glass 5% Carbonates Quartz Binder/Filler 95%
		LAYER 3 Roofing, Black	No	None Detected	Fibrous Glass 15% Synthetic Fiber 5% Carbonates Quartz Binder/Filler 80%
		LAYER 4 Roofing, Black	No	None Detected	Cellulose Fiber 15% Fibrous Glass 5% Carbonates Quartz Binder/Filler 80%

Please see EMC Labs Sample Number 0212546-026 for Additional Layers

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Laboratory Report

**0212546**

## Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	TRC SOLUTIONS	Job# / P.O. #:	321417
Address:	4105 SE INTERNATIONAL WAY	Date Received:	12/10/2018
	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-010 CMES-15A		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber <1% Carbonates Quartz Binder/Filler 99%
		LAYER 2 Roofing, Black	No	None Detected	Cellulose Fiber 15% Fibrous Glass 5% Carbonates Quartz Binder/Filler 80%
		LAYER 3 Roofing, Gray/ Tan	No	None Detected	Fibrous Glass 5% Carbonates Quartz Binder/Filler 95%
		LAYER 4 Roofing, Black	No	None Detected	Fibrous Glass 15% Synthetic Fiber 3% Cellulose Fiber 2% Carbonates Quartz Binder/Filler 80%

**Please see EMC Labs Sample Number 0212546-027 for Additional Layers**

0212546-011 CMES-15B		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber <1% Carbonates Quartz Binder/Filler 99%
		LAYER 2 Roofing, Black	No	None Detected	Fibrous Glass 15% Synthetic Fiber 5% Carbonates Quartz Binder/Filler 80%
		LAYER 3 Roofing, Black	No	None Detected	Fibrous Glass 15% Synthetic Fiber 3% Cellulose Fiber 2% Carbonates Quartz Binder/Filler 80%

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## **Bulk Asbestos Analysis by Polarized Light Microscopy**

NVLAP#101926-0

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	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-012 CMES-16A		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber 1% Carbonates Quartz Gypsum Binder/Filler 99%
		LAYER 2 Roofing, Gray/ Tan	No	None Detected	Fibrous Glass 5% Cellulose Fiber <1% Carbonates Quartz Binder/Filler 94%
		LAYER 3 Roofing, Black	No	None Detected	Fibrous Glass 17% Cellulose Fiber 3% Carbonates Quartz Binder/Filler 80%
		LAYER 4 Roofing, Black	No	None Detected	Fibrous Glass 15% Cellulose Fiber 5% Carbonates Quartz Binder/Filler 80%

Please see EMC Labs Sample Number 0212546-028 for Additional Layers



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**0212546**

## Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

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	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-013 CMES-16B		LAYER 1 Roofing, Black	No	None Detected	Cellulose Fiber 10% Carbonates Quartz Gypsum Binder/Filler 90%
		LAYER 2 Roofing, Gray/ Tan	No	None Detected	Fibrous Glass 5% Carbonates Quartz Binder/Filler 95%
		LAYER 3 Roofing, Black	No	None Detected	Fibrous Glass 5% Synthetic Fiber <1% Carbonates Quartz Binder/Filler 94%
		LAYER 4 Roofing, Black	No	None Detected	Fibrous Glass 20% Carbonates Quartz Binder/Filler 80%

Please see EMC Labs Sample Number 0212546-029 for Additional Layers

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NVLAP#101926-0

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	STE 505	Date Analyzed:	12/13/2018
	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-014 CMES-17A		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber 1%
					Carbonates
					Quartz
					Binder/Filler 99%
		LAYER 2 Roofing, Black	No	None Detected	Cellulose Fiber 15%
					Synthetic Fiber 3%
					Fibrous Glass 2%
					Carbonates
					Quartz
					Binder/Filler 80%
		LAYER 3 Roofing, Black	No	None Detected	Fibrous Glass 15%
					Synthetic Fiber 3%
					Cellulose Fiber 2%
					Carbonates
					Quartz
					Binder/Filler 80%
		LAYER 4 Roofing, Black	No	None Detected	Fibrous Glass 15%
					Synthetic Fiber 3%
					Cellulose Fiber 2%
					Carbonates
					Quartz
					Binder/Filler 80%

Please see EMC Labs Sample Number 0212546-030 for Additional Layers

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	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-015 CMES-17B		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber 1% Carbonates Quartz Binder/Filler 99%
		LAYER 2 Roofing, Black	No	None Detected	Fibrous Glass 10% Synthetic Fiber 10% Carbonates Quartz Binder/Filler 80%
		LAYER 3 Roofing, Black	No	None Detected	Fibrous Glass 10% Synthetic Fiber 10% Carbonates Quartz Binder/Filler 80%
		LAYER 4 Roofing, Black	No	None Detected	Fibrous Glass 15% Synthetic Fiber 3% Cellulose Fiber 2% Carbonates Quartz Binder/Filler 80%

**Please see EMC Labs Sample Number 0212546-031 for Additional Layers**

0212546-016 CMES-18A		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber <1% Carbonates Quartz Binder/Filler 99%
		LAYER 2 Roof Mastic, Black	No	None Detected	Cellulose Fiber 7% Carbonates Quartz Binder/Filler 93%

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STE 505 Date Analyzed: 12/13/2018  
MILWAUKIE OR 97222  
Collected: 12/07/2018 Date Reported: 12/13/2018  
Project Name: BSD-CEDAR MILL ES, HVAC UPGRADE EPA Method: EPA 600/R-93/116  
Address: Submitted By: JASON STONE  
Collected By:

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-017 CMES-18B		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber <1% Carbonates Quartz Binder/Filler 99%
		LAYER 2 Roof Mastic, Black	No	None Detected	Cellulose Fiber 7% Carbonates Quartz Binder/Filler 93%
		LAYER 1 Roofing, Silver	No	None Detected	Cellulose Fiber <1% Carbonates Quartz Binder/Filler 99%
		LAYER 2 Roof Mastic, Black	No	None Detected	Cellulose Fiber 7% Carbonates Quartz Binder/Filler 93%
0212546-019 CMES-11A	ADDITIONAL LAYERS	LAYER 1 Roofing, Black/ Gray	No	None Detected	Cellulose Fiber 85% Fibrous Glass 10% Gypsum Binder/Filler 5%
		LAYER 2 Roofing, Yellow	No	None Detected	Foam Gypsum Binder/Filler 100%
	ADDITIONAL LAYERS	LAYER 1 Roofing, Black/ Gray	No	None Detected	Cellulose Fiber 85% Fibrous Glass 10% Gypsum Binder/Filler 5%
		LAYER 2 Roofing, Yellow	No	None Detected	Foam Gypsum Binder/Filler 100%

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	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-021 CMES-11C	ADDITIONAL LAYERS	LAYER 1 Roofing, Black/ Gray	No	None Detected	Cellulose Fiber 85% Fibrous Glass 10% Gypsum Binder/Filler 5%
		LAYER 2 Roofing, Yellow	No	None Detected	Foam Gypsum Binder/Filler 100%
0212546-022 CMES-12B	ADDITIONAL LAYERS	LAYER 1 Roofing, Black/ Gray	No	None Detected	Cellulose Fiber 85% Fibrous Glass 10% Gypsum Binder/Filler 5%
		LAYER 2 Roofing, Yellow	No	None Detected	Foam Gypsum Binder/Filler 100%
0212546-023 CMES-13A	ADDITIONAL LAYERS	LAYER 1 Roofing, Beige/ Tan	No	None Detected	Cellulose Fiber 95% Gypsum Binder/Filler 5%
		LAYER 2 Roofing, Gray/ Tan	No	None Detected	Cellulose Fiber 75% Perlite Gypsum Binder/Filler 25%
0212546-024 CMES-13B	ADDITIONAL LAYERS	LAYER 1 Roofing, Black/ Gray	No	None Detected	Cellulose Fiber 85% Fibrous Glass 10% Gypsum Binder/Filler 5%
		LAYER 2 Roofing, Yellow	No	None Detected	Foam Gypsum Binder/Filler 100%

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Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0212546-025 CMES-14A	ADDITIONAL LAYERS	LAYER 1 Roofing, Black	No	None Detected	Cellulose Fiber	15%
					Carbonates Gypsum Quartz Binder/Filler	85%
		LAYER 2 Roofing, Brown/ Tan	No	None Detected	Cellulose Fiber	90%
					Gypsum Binder/Filler	10%
0212546-026 CMES-14B	ADDITIONAL LAYERS	LAYER 1 Roofing, Black	No	None Detected	Synthetic Fiber Cellulose Fiber	15% 5%
					Carbonates Gypsum Quartz Binder/Filler	80%
		LAYER 2 Roofing, Brown/ Tan	No	None Detected	Cellulose Fiber	90%
					Gypsum Binder/Filler	10%
0212546-027 CMES-15A	ADDITIONAL LAYERS	LAYER 1 Roofing, Black	No	None Detected	Synthetic Fiber Cellulose Fiber	15% 5%
					Carbonates Gypsum Quartz Binder/Filler	80%
		LAYER 2 Roofing, Brown/ Tan	No	None Detected	Cellulose Fiber	90%
					Gypsum Binder/Filler	10%

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Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-028 CMES-16A	ADDITIONAL LAYERS	LAYER 1 Roofing, Black	No	None Detected	Fibrous Glass 20% Cellulose Fiber 2% Carbonates Quartz Binder/Filler 78%
		LAYER 2 Roofing, Beige	No	None Detected	Cellulose Fiber 75% Carbonates Binder/Filler 25%
0212546-029 CMES-16B	ADDITIONAL LAYERS	LAYER 1 Roofing, Black	No	None Detected	Fibrous Glass 20% Cellulose Fiber 2% Carbonates Quartz Binder/Filler 78%
		LAYER 2 Roofing, Beige	No	None Detected	Cellulose Fiber 75% Carbonates Binder/Filler 25%
0212546-030 CMES-17A	ADDITIONAL LAYERS	LAYER 1 Roofing, Black	No	None Detected	Synthetic Fiber 15% Cellulose Fiber 5% Carbonates Gypsum Quartz Binder/Filler 80%
		LAYER 2 Roofing, Brown/ Tan	No	None Detected	Cellulose Fiber 90% Gypsum Binder/Filler 10%

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	MILWAUKIE OR 97222		
Collected:	12/07/2018	Date Reported:	12/13/2018
Project Name:	BSD-CEDAR MILL ES, HVAC UPGRADE	EPA Method:	EPA 600/R-93/116
Address:		Submitted By:	JASON STONE
		Collected By:	

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents
0212546-031 CMES-17B	ADDITIONAL LAYERS	LAYER 1 Roofing, Black	No	None Detected	Synthetic Fiber 15% Cellulose Fiber 5% Carbonates Gypsum Quartz Binder/Filler 80%
		LAYER 2 Roofing, Brown/ Tan	No	None Detected	Cellulose Fiber 90% Gypsum Binder/Filler 10%



Analyst - Octavio Gavarreteayestas



Signatory - Lab Director - Kurt Kettler

Distinctly stratified, easily separable layers of samples are analyzed as subsamples of the whole and are reported separately for each discernible layer. All analyses are derived from calibrated visual estimate and measured in area percent unless otherwise noted. The report applies to the standards or procedures identified and to the sample(s) tested. The test results are not necessarily indicated or representative of the qualities of the lot from which the sample was taken or of apparently identical or similar products, nor do they represent an ongoing quality assurance program unless so noted. These reports are for the exclusive use of the addressed client and that they will not be reproduced wholly or in part for advertising or other purposes over our signature or in connection with our name without special written permission. The report shall not be reproduced except in full, without written approval by our laboratory. The samples not destroyed in testing are retained a maximum of thirty days. The laboratory measurement of uncertainty for the test method is approximately less than 1 by area percent. Accredited by the National Institute of Standards and Technology, Voluntary Laboratory Accreditation Program for selected test method for asbestos. The accreditation or any reports generated by this laboratory in no way constitutes or implies product certification, approval, or endorsement by the National Institute of Standards and Technology. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government. Polarized Light Microscopy may not be consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials.



# CHAIN OF CUSTODY

EMC Labs, Inc.  
9830 S. 51<sup>st</sup> St., Ste B-109  
Phoenix, AZ 85044  
(800) 362-3373 Fax (480) 893-1726

LAB#: 212048  
TAT: 3 day  
Rec'd: NOV 30 P.M.

COMPANY NAME: **TRC SOLUTIONS**  
4105 SE International Way, Suite 505  
Milwaukie, Oregon 97222

CONTACT: Ron Landolt **Scan & Excel**  
Phone/Fax: (503) 387-3251 / (503) 908-1318  
Email: rlandolt@trcsolutions.com

BILL TO: (If Different Location)  
Phoenix, AZ

Now Accepting: **VISA - MASTERCARD**

Price Quoted: \$ \_\_\_\_\_ / Sample \$ \_\_\_\_\_ / Layers

**COMPLETE ITEMS 1-4: (Failure to complete any items may cause a delay in processing or analyzing your samples)**

**1. TURNAROUND TIME:** [4hr rush] [8hr rush] [1-Day] [2-Day] [3-Day] [5-Day] [6-10 Day]

\*\*\*\*Prior confirmation of turnaround time is required

\*\*\*\*Additional charges for rush analysis (please call marketing department for pricing details)

\*\*\*\*Laboratory analysis may be subject to delay if credit terms are not met

**2. TYPE OF ANALYSIS:** [Bulk-PLM] [Air-PCM] [Lead] [Point Count] [Fungi: AOC, W-C, Bulk, Swab, Tape]

**3. DISPOSAL INSTRUCTIONS:** [Dispose of samples at EMC] / [Return samples to me at my expense]

(If you do not indicate preference, EMC will dispose of samples 60 days from analysis.)

**4. Project Name:** BSD-Cedar Mill ES, HVAC upgrade

P.O. Number: \_\_\_\_\_ Project Number: 321417

EMC SAMPLE #	CLIENT SAMPLE #	DATE & TIME SAMPLED	LOCATION/MATERIAL TYPE	Samples Accepted Yes / No	AIR SAMPLE INFO / COMMENTS		
					ON	OFF	FLOW RATE
34 31	CMES-01A	11/28/18	See Attached field log	Y N			
				Y N			
				Y N			
				Y N			
				Y N			
				Y N			
				Y N			
				Y N			
				Y N			
				Y N			
	CMES-00B			Y N			
				Y N			
				Y N			
				Y N			
				Y N			
				Y N			
				Y N			
				Y N			

**SPECIAL INSTRUCTIONS:**

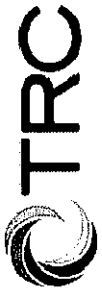
Sample Collector: (Print) Math Casda (Signature) [Signature]

Relinquished by: [Signature] Date/Time: 11-29-18 100 Received by: Diana Federico Date/Time: 11/30/18

Relinquished by: Diana Federico Date/Time: 11/30/18 Received by: [Signature] Date/Time: 11/30/18

Relinquished by: \_\_\_\_\_ Date/Time: \_\_\_\_\_ Received by: \_\_\_\_\_ Date/Time: \_\_\_\_\_

\*\* In the event of any dispute between the above parties for these services or otherwise, parties agree that jurisdiction and venue will be in Phoenix, Arizona and prevailing party will be entitled to attorney's fees and court costs.



ASBESTOS INSPECTION FIELD DATA SHEET

Project #: 321417

Name: BSD - Cedar Mill E.S HVAC Upgrade

Location: 10265 NW Cornell Road, Portland, OR

Inspector Name and License #:

Date of Inspection: 11-28-18

Inspector Signature: [Signature]

Page 1 of 2

Sample #	Material Description	Sample Location	Quantity (SF or LF)	Friability (NF or F)	Damage (ND, D, SD)
CMES-01A	Pipe Run Insulation (Steam Lines)	Gym Attic			
CMES-01B		Tunnel Access in Boy's Restroom			
CMES-01C		Tunnel under A110			
CMES-02A	Pipe Fitting Insulation (Steam Lines)	Gym Attic			
CMES-02B		Tunnel Access in Boy's Restroom			
CMES-02C		Tunnel under A110			
CMES-03A	HVAC Vibration Damper Cloth (Gym Attic Unit)	Gym Attic			
CMES-04A	1' x 1' Ceiling Tile, Even Holes and Brown Glue	Lower Gym Storage Hallway			
CMES-04B		Staff Lounge			
CMES-04C		Staff Lounge			
CMES-05A	1' x 1' Ceiling Tile, Random Holes and Brown Glue	Main Hallway			
CMES-05B		A118			
CMES-05C		Cafeteria			
CMES-06A	Gypsum Board and Joint Compound	Boy's Restroom Custodial Closet			
CMES-06B		Room A108			
CMES-06C		Room A120			
CMES-06D		Kitchen Restroom Closet			
CMES-06E		Cafeteria Hot Water Closet			
CMES-06F		Custodial Closet A126			
CMES-06G		Room A100 Closet			
CMES-07A	Carpet Glue	Room A108			
CMES-07B		Room A122			
CMES-07C		Custodial Closet A126			



Page 2 of 2

Inspector Name and License #:

Date of Inspection: 11-28-15

Inspector Signature:

~~20~~ ~~21~~ ~~22~~ ~~23~~ 24 25 26 27 28 29 30 31

## CHAIN OF CUSTODY

EMC Labs, Inc.  
 9830 S. 51<sup>st</sup> St., Ste B-109  
 Phoenix, AZ 85044  
 (480) 940-5294 Fax (480) 893-1726

LAB#: 212546TAT: 3 dayRec'd: DEC 10 AM

COMPANY NAME: TRC SOLUTIONS  
 Address: 4105 SE International Way, Suite 505  
Milwaukie, Oregon 97222  
 CONTACT: Ron Landolt Scan & Excel  
 Phone/Fax: (503) 387-3251 / (503) 908-1318  
 Email: randolt@trcsolutions.com and micola@trcsolutions.com

BILL TO: \_\_\_\_\_ (If Different Location)  
 Phoenix, AZ \_\_\_\_\_

Now Accepting: VISA - MASTERCARD

Price Quoted: \$ \_\_\_\_\_ / Sample \$ \_\_\_\_\_ / Layers

COMPLETE ITEMS 1-4: (Failure to complete any items may cause a delay in processing or analyzing your samples)

1. TURNAROUND TIME: [Same Day Rush] [1-2 Days] [3-4-5 Days] [6-10 Days]\*\*\*\*Prior confirmation of turnaround time is required

\*\*\*\*Additional charges for rush analysis (please call marketing department for pricing details)

\*\*\*\*Laboratory analysis may be subject to delay if credit terms are not met

2. TYPE OF ANALYSIS: [Bulk-PLM] [Air-PCM] [Lead] [Point Count] [Fungi: AOC, W-C, Bulk, Swab, Tape]

3. DISPOSAL INSTRUCTIONS: [Dispose of samples at EMC] / [Return samples to me at my expense]

(If you do not indicate preference, EMC will dispose of samples 30 days from analysis.)

4. Project Name: BSD Cedar Mill E.S. HVAC Upgrade

P.O. Number: \_\_\_\_\_

Project Number: 321417

EMC SAMPLE #	CLIENT SAMPLE #	DATE & TIME SAMPLED	LOCATION/MATERIAL TYPE	Samples Accepted Yes / No	AIR SAMPLE INFO / COMMENTS		
					ON	OFF	FLOW RATE
1	CMES-11A	12/2/18	Roof (Gym)	Y N			
2	-11B			Y N			
3	-11C			Y N			
4	-12A		Build-up Roof	Y N			
5	-12B			Y N			
6	-13A			Y N			
7	-13B			Y N			
8	-14A			Y N			
9	-14B			Y N			
10	-15A			Y N			
11	-15B			Y N			
12	-16A			Y N			
13	-16B			Y N			
14	-17A			Y N			
15	-17B			Y N			

## SPECIAL INSTRUCTIONS:

Sample Collector: (Print) Jason Stone(Signature) Jason StoneRelinquished by: Jason Stone Date/Time: 12/7/18 Received by: Diana Federico Date/Time: 12/10/18Relinquished by: Diana Federico Date/Time: 12/10/18 Received by: [Signature] Date/Time: 12/10/18

Relinquished by: \_\_\_\_\_ Date/Time: \_\_\_\_\_ Received by: \_\_\_\_\_ Date/Time: \_\_\_\_\_

\*\* In the event of any dispute between the above parties for these services or otherwise, parties agree that jurisdiction and venue will be in Phoenix, Arizona and prevailing party will be entitled to attorney's fees and court costs.

## CHAIN OF CUSTODY

EMC Labs, Inc.  
9830 S. 51<sup>st</sup> St., Ste B-109  
Phoenix, AZ 85044  
(480) 940-5294 Fax (480) 893-1726

LAB#:

TAT:

Rec'd:

COMPANY NAME: **TRC SOLUTIONS**  
Address: 4105 SE International Way, Suite 505  
Milwaukie, Oregon 97222  
CONTACT: Ron Landolt **Scan & Excel**  
Phone/Fax: (503) 387-3251 / (503) 908-1318  
Email: [randolt@trcsolutions.com](mailto:randolt@trcsolutions.com) and [moulton@trcsolutions.com](mailto:moulton@trcsolutions.com)

BILL TO: (If Different Location)

Phoenix, AZ

Now Accepting: **VISA - MASTERCARD**

Price Quoted: \$ \_\_\_\_\_ / Sample \$ \_\_\_\_\_ / Layers

**COMPLETE ITEMS 1-4: (Failure to complete any items may cause a delay in processing or analyzing your samples)**1. **TURNAROUND TIME:** [Same Day Rush] [1-2 Days] [3-4-5 Days] [6-10 Days]\*\*\*\*Prior confirmation of turnaround time is required

\*\*\*\*Additional charges for rush analysis (please call marketing department for pricing details)

\*\*\*\*Laboratory analysis may be subject to delay if credit terms are not met

2. **TYPE OF ANALYSIS:** [Bulk-PLM] [Air-PCM] [Lead] [Point Count] [Fungi: AOC, W-C, Bulk, Swab, Tape]3. **DISPOSAL INSTRUCTIONS:** [Dispose of samples at EMC] / [Return samples to me at my expense]

(If you do not indicate preference, EMC will dispose of samples 30 days from analysis.)

4. **Project Name:** BSD - Cedar Mill E.S. HVAC Upgrade

P.O. Number:

Project Number: 321417

EMC SAMPLE #	CLIENT SAMPLE #	DATE & TIME SAMPLED	LOCATION/MATERIAL TYPE	Samples Accepted Yes / No	AIR SAMPLE INFO / COMMENTS		
					ON	OFF	FLOW RATE
16	CMES-18A	12/7/18	Roof Mastic	Y N			
17	-18B	↓	↓	Y N			
18	-18C	↓	↓	Y N			
19	CMES-11A	↓	ADDITIONAL LAYERS	Y N			
20	-11B	↓	↓	Y N			
21	-11C	↓	↓	Y N			
22	-12B	↓	↓	Y N			
23	-13A	↓	↓	Y N			
24	-13B	↓	↓	Y N			
25	-14A	↓	↓	Y N			
26	-14B	↓	↓	Y N			
27	-15A	↓	↓	Y N			
28	-15B	↓	↓	Y N			
29	-16A	↓	↓	Y N			
30	-16B	↓	↓	Y N			
31	-17B	↓	↓	Y N			

## SPECIAL INSTRUCTIONS:

Sample Collector: (Print) Jason Stone(Signature) Jason StoneRelinquished by: Jason Stone Date/Time: 12/7/18 Received by: Diana Federico Date/Time: 12/10/18Relinquished by: Diana Federico Date/Time: 12/10/18 Received by: At Date/Time: 12/10/18

Relinquished by: \_\_\_\_\_ Date/Time: \_\_\_\_\_ Received by: \_\_\_\_\_ Date/Time: \_\_\_\_\_

\*\* In the event of any dispute between the above parties for these services or otherwise, parties agree that jurisdiction and venue will be in Phoenix, Arizona and prevailing party will be entitled to attorney's fees and court costs.

## **Appendix C – Inspector Certification(s)**

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# ***The Environmental Institute***

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## ***Matthew Cuda***

---

Social Security Number - XXX-XX-8274

TRC Solutions - 4105 SE International Way, Suite 505 - Milwaukie, Oregon 97222

*Has completed coursework and satisfactorily passed  
an examination that meets all criteria required for  
EPA/AHERA/ASHARA (TSCA Title II) Approved Reaccreditation*

### ***Asbestos in Buildings: Inspector Refresher***

***February 2, 2018***

Course Date

***16657***

Certificate Number

***February 2, 2018***

Examination Date

***February 1, 2019***

Expiration Date



*Thomas G. Laubenthal*

Thomas G. Laubenthal - Principal Instructor

*Rachel G. McCain*

Rachel G. McCain - Exam Administrator

*David W. Hogue*

David W. Hogue - Training Manager

(Approved by the ABIH Certification Maintenance Committee for 1/2 CM point - Approval #11-577)

(Florida Provider Registration Number FL49-0001342 - Course #FL49-0002805)

TEI - 1841 West Oak Parkway, Suite F - Marietta, Georgia 30062 - (770) 427-3600 - [www.tei-atl.com](http://www.tei-atl.com)



# Certificate of Completion

This is to certify that

**Jason Stone**

has satisfactorily completed  
4 hours of refresher training as an  
AHERA Building Inspector

to comply with the training requirements of  
TSCA Title II, 40 CFR 763 (AHERA)

164935

Certificate Number



Dec 18, 2017 Expires in 1 year.

Date(s) of Training

Exam Score:  
if appropriate:

A handwritten signature in black ink, appearing to read "J. Stone", written over a horizontal line.

Instructor

ARGUS PACIFIC, INC / 1900 WEST NICKERSON ST, SUITE 315 / SEATTLE, WASHINGTON 98119 / 206.285.3373 / ARGUSPACIFIC.COM



JASON CHRISTOPHER STONE  
650 SE 154TH AVE  
PORTLAND OR 97233

CONSTRUCTION CONTRACTORS BOARD  
LEAD BASED PAINT RISK ASSESSOR LICENSE  
LICENSE NO.: 9151698-RA  
EXPIRATION DATE: 10/4/2019

This document certifies that

JASON CHRISTOPHER STONE  
650 SE 154TH AVE  
PORTLAND OR 97233

is licensed in accordance with Oregon Law as a  
Lead Based Paint Risk Assessor

**STATE OF OREGON**  
**CONSTRUCTION CONTRACTORS BOARD**  
**LEAD BASED PAINT RISK ASSESSOR LICENSE**

LICENSE NUMBER: 9151698-RA

This document certifies that

JASON CHRISTOPHER STONE  
650 SE 154TH AVE  
PORTLAND OR 97233

is licensed in accordance with Oregon Law as a Lead Based Paint Risk Assessor

**License Details:**

LICENSE NO.: 9151698-RA  
EXPIRATION DATE: 10/4/2019

1 GENERAL

- 1.01 GENERAL REQUIREMENTS: Drawings and general provisions of the Contract, including General and other conditions and Division 1 - General requirements Sections apply for the work specified in this Section.
- 1.02 SCOPE OF WORK: The work covered by this Specification shall include furnishing all labor, materials, equipment and services to construct and install the complete mechanical system as shown on the Drawings and specified herein. Verify all conditions on the job site and lay out work accordingly.
- 1.03 RELATED WORK:
- A. The General Provisions apply to this Division, including but not limited to:
    - 1. Drawings and Specifications.
    - 2. Contract Modifications, addendums and change orders.
  - B. Division 1, General Requirements, applies to this Division, including but not limited to:
    - 1. Summary of Work.
    - 2. Coordination. In addition, it shall be the responsibility of each trade performing work specified under Division 23 to coordinate with all others for proper and adequate installation clearance.
    - 3. Cutting and Patching. The cost of cutting and patching required work of Division 23 and not shown in other Divisions of Work shall be included in the cost of Division 23.
    - 4. Shop Drawings, Product Data and Samples.
    - 5. Temporary Facilities and Controls.
    - 6. Material and Equipment.
    - 7. Substitutions and Product Options.
    - 8. Contract Closeout.
      - a. Project Record Documents. Keep up to date marked up Drawings on site.
      - b. Operations and Maintenance Data.
      - c. Start-up.

C. Related work provided in Divisions 2 through 14:

1. Pipe chases and formed concrete work except as specified hereunder.
2. Framed openings in masonry, concrete, wood and other architectural and structural elements.
3. Wood grounds and nailing strips in masonry and concrete.
4. Installation only of access panels in ceilings, walls, etc. Provide access panels as part of mechanical work.
5. Painting except as specified hereunder.
6. Curbs and roof flashings for openings through roofs, except for roof drain and vent pipe flashing.

D. Related Work provided in Division 26 and 28:

1. Motor disconnect switches and installation except as specified herein.
2. Motor starters and installation except as herein specified.
3. Power wiring except as specified herein.

1.04 QUALITY ASSURANCE:

A. Regulatory Requirements:

1. All work, installations, materials and equipment shall comply with the provision of the following codes, standards and regulations, except where more stringent requirements are shown or specified:
  - a. State of Oregon International Mechanical Code. (IMC)
  - b. State of Oregon Plumbing Specialty Code. (UPC)
  - c. State of Oregon Structural Specialty Code. (IBC)
  - d. National Electrical Code. (NEC)
  - e. National Fire Protection Agency. (NFPA)
  - f. All City, County, State and Federal applicable laws and regulations.
  - g. Regulations and standards set forth by ASME, ASHRAE, SMACNA, AGA and ARI.
2. Should there be any direct conflict between Codes and the Drawings and Specifications, the Codes, rules and regulations shall govern.
3. Where two or more codes or regulations apply, the more stringent of the two shall be exercised.

4. Should the Documents indicate a condition, which will conflict with the Codes, the Contractor shall inform the Owner's Representative and refrain from installing that portion until resolved. Any work installed in violation of the Codes will be removed and correctly installed as part of the Contract work.
  5. If the Drawings and Specifications indicate a higher quality than code, the Drawings and Specifications shall govern.
  6. Electrical products shall bear the U.L. label.
- B. The entire mechanical system shall operate correctly at full capacity without objectionable noise, vibration or decrease of efficiency.
- C. Materials and Equipments:
1. Equipment furnished shall meet all requirements of the Drawings and Specifications and be suitable for the installation. Equipment not meeting all requirements will not be acceptable.
  2. Where two or more units of the same class of equipment are furnished, use products of the same manufacturer.
  3. Furnish all materials and equipment, new and of size, type and quality herein specified.
- D. Workmanship:
1. Follow manufacturers' instructions. If they are in conflict with the Drawings and Specifications, obtain clarification from the Architect prior to beginning the work.
- E. Cutting and Patching:
1. Provide for cutting, patching and repairing for the installation of the work specified, including masonry work, concrete work, carpentry work and painting. Work shall be performed by skilled craftsmen of the respective trade.

1.05 DRAWINGS:

- A. The Drawings and Specifications are complementary and what is called for by one shall be as if called for by both. All items shown on the Drawings are not necessarily included in the Specifications. All directives and instructions to furnish, provide, install, complete and test described in the design documents shall be interpreted as directives unless clearly specified otherwise.
- B. Bring obscure or questionable items to the attention of the Owner's Representative prior to bid date. Necessary directions and explanations will be given by the Owner's Representative in Addendum Form.



- C. Should the Documents indicate a condition which will conflict with the Governing Codes and Regulations, the Contractor shall refrain from installing that portion of the work until receiving verification from the Owner's Representative. Should rearrangement or rerouting of duct or piping be necessary, provide for approval the simplest layout possible for that particular portion of the work. Any work installed in violation of the Governing Codes will be removed and correctly installed by the Contractor as part of the Contract work.
- D. Drawings are diagrammatic. They do not show every offset, bend, tee, or elbow which may be required to install work in the space provided. Do not scale drawings for roughing-in measurements, nor use as shop drawings. Make field measurements and prepare shop drawings as required. Coordinate work with shop drawings of other trades. Provide any bends, offsets and elbows where required by local conditions from measurements taken at the Building (subject to approval) and without additional cost to the Project. The right is reserved to make any reasonable changes in outlet location prior to rough-in.
- E. It is the intent of these specifications that the field wiring of all systems provided and modified under this contract shall be complete and operable. Refer to all drawings and specifications, especially the electrical drawings, to determine voltage, phase, circuit ampacity and number of connections indicated. Bring to the attention of the Engineer all conflicts, incompatibilities and discrepancies prior to bid.
- F. Where equipment is shown, dimensions have been taken from typical equipment of the class indicated. Carefully check the Drawings to see that the equipment under consideration for installation will fit the space provided and that all connections may be made thereto without impairment of space and height requirements and of Code required clearances. Contractor is responsible for all changes required by equipment dimensions different than those shown.
- G. Where equipment manufacturer and model number are listed it is the most recent and/or desired to describe function and quality of equipment to be supplied and installed. Since manufacturers may change model numbers without notification, should the model specified be unavailable, furnish and install the model number that is equal to or better than the one listed.
- H. The location of all utilities, wires, conduits, pipes, duct, or other service facilities are shown in a general way only on the Drawings and are taken from existing public records. Ascertain whether any additional facilities other than those shown on the plans may be present and determine the exact location and elevations of all utilities prior to commencing installation.
- I. Prior to bid, contact the local utility companies to verify requirements. Provide all material and labor by utilities.
- J. The Contractor, before submitting a Bid on the work, must visit the site to become familiar with all visible existing conditions. As a result of having visited the premises, the Contractor shall be responsible for the installation of the work as it relates to such visible existing conditions. The submission of the bid will be considered an acknowledgement of the part of the Bidder of visitation to the site.
- K. The Contractor is responsible to apply for and obtain all necessary permits, fees and inspections required by any public authority having jurisdiction. Refer to General Conditions for additional information.

1.06 SUBSTITUTION AND PRODUCT OPTIONS:

- A. See Division 1.
- B. The use of manufacturer's names, models and numbers in the Drawings and Specifications is intended to establish style, quality, appearance and usefulness. The model numbers listed are the last available to the designer, if no longer current, substitute equipment equal to or better than that represented by the model number listed. Items noted "or equivalent" will require prior acceptance.
- C. Submit for the Owner's Representative's review, manufacturer's detailed specifications and data sheets for all proposed substitutions. Submittals shall consist of a single sheet, or specific data need for consideration of approval. All pertinent data listed in the Specifications and on the Drawings shall be furnished, including all special features. See that all submittals are in proper order, and that all equipment will fit the space provided.
- D. All requests for approval of substitutions for materials other than those specified must be submitted in accordance with Instruction to Bidder.
- E. Substitution products from approved manufacturers do not need prior approval. Ensure substitutions meet all requirements of the Specifications.
- F. All changes required due to product substitutions are the responsibility of the Contractor.

1.07 PROJECT RECORD DRAWINGS:

- A. Obtain drawings from Architect.
- B. Keep Drawings clean, undamaged and up to date.
- C. Record and accurately indicate the following:
  - 1. Depths, sizes and locations of all buried and concealed piping.
  - 2. Locations of all clean-outs.
  - 3. Changes, additions and revisions due to contract modifications.
  - 4. Locations of tracer wire terminal points.
- D. Drawings to be available for Architect review.
- E. Submit as a part of Project Closeout Documents

1.08 PROJECT CONDITIONS:

- A. Existing Conditions: Prior to bidding, verify and become familiar with all existing conditions by visiting the site and include all factors which may affect the execution of this work. Include all related costs in the initial bid proposal.

- B. Coordinate exact requirements governed by actual job conditions. Check all information and report all discrepancies before fabrication work. Report changes in the time to avoid unnecessary work. Make changes as directed by Owner's Representative.

1.09 CONTRACT MODIFICATIONS:

- A. In addition to the requirements of the General provisions, all supplemental cost proposals for this Division of work shall be accompanied by a complete itemized breakdown of labor and materials for each item. No exceptions will be made. Contract's estimating sheets for supplemental cost proposals shall be made available upon request. Labor must be separated and allocated to each item of work. Changes or additions subject to additional compensation made without written authorization based on agreed price shall be at Contractor's own risk and expense.

1.10 STORAGE AND HANDLING:

- A. Delivery: Deliver to project site with manufacturer's labels intact and legible.
- B. Handling: Avoid damage.
- C. Storage: Store material inside, protected from weather, dirt and construction dust. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

1.11 WARRANTY:

- A. Provide a written guaranty covering the work of this Division for a period of one calendar year from the date of acceptance of the entire project as required by the General Provisions.
- B. Provide manufacturer's written warranties for material and equipment furnished under this Division insuring parts and labor for a period of one year minimum, or longer as required by other sections, from the date of acceptance of the entire project.
- C. Correct warranty items promptly upon notification.

1.12 OPERATIONS AND MAINTENANCE DATA:

- A. Prior to final inspection, provide one (1) electronic copy of manufacturer's maintenance manuals for each piece of equipment or items requiring service. Manual shall include manufacturer's operation and maintenance instruction manuals and parts list for each piece of equipment or item requiring servicing. Include in the manual manufacturer's service data, wiring diagrams and parts lists for all major items of equipment, valve charts, balancing data, final control diagrams showing final set points and any additional equipment added by contract modification. Comply with provisions of Section 01700 where applicable.
- B. Prepare project cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of file when multiple files are required.
- C. Internally subdivide the file contents with section dividers, logically organized with electronic bookmarks.

- D. Provide one (1) final copy of manual in electronic pdf format through owner's eBuilder Closeout Process system after approval of contents.

1.13 SUBMITTALS:

- A. Shop Drawings: The Contract Drawings indicate the general layout of the piping, ductwork and various items of equipment. Prepare and submit for review Shop Drawings of all installation not detailed on the Contract Drawings and all changes to the Contract Drawings.
- B. Product Data:
  - 1. Submit for review manufacturer's detailed shop drawings, specifications and stat sheets for all equipment to be furnished, as well as any wiring diagram showing field installed wiring and devices. Arrangement of mechanical equipment has been based on items of specific manufacturer intended as somewhat typical of several makes, which may be approved.
  - 2. Indicate construction, capacities, accessories, etc. Manufacturer's abbreviations or codes are not acceptable.
  - 3. List the name of the motor manufacturer for each piece of equipment.
- C. Submission Requirements:
  - 1. Shop Drawings and Product Data:
    - a. Submit all equipment and product data for Work of Division 23 in accordance with Beaverton School District requirements and together in a single group with each item field under a section, and labeled with its respective speciation section number, article and paragraph, and mark if applicable.
    - b. Include a complete index in the original submittal. Indicate both original items submitted and note stragglers that will be submitted at a later date to avoid delay in submitting.
    - c. Additional product data submitted after return of the original binder shall include a tab similar to the originally submitted. Upon receipt of the return submittal, insert them in the previously submitted binder.
    - d. Refer to Division 1 for number of shop drawing copies to be submitted.
  - 2. Sample: Submit samples required by each Section of Division 23 at the same time that shop drawings and product data are submitted.
- D. It shall be the Contractor's responsibility to:
  - 1. See that all submittals are in proper order.
  - 2. Insure that all equipment will fit in the space provided.



3. Assure that all deviation from Drawings and Specification are specifically noted and called to the attention of the Engineer/Architect/Contracting Officer in the submittals. Failure to comply will void approval automatically.
4. Deviation, discrepancies, and conflicts between the submittals and the contract documents discovered prior to or after the review process shall not relieve the Contractor of this responsibility to comply with the contract documents.

1.14 START-UP:

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Owner's Representative seven days prior to start-up of each item.
- C. Verify that each piece of equipment of system has been checked prior to start-up for proper lubrication, drive rotation, belt tension, control sequence, or other conditions, which may cause damage.
- D. Verify that tests, meter readings and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are completed and tested.
- F. Execute start-up under supervision of responsible manufacturer's representative or Contractor's personnel in accordance with manufacturer's instructions.

1.15 FEES, PERMITS AND INSPECTIONS: The Contractor is responsible to apply for and obtain all necessary permits, fees and inspections required by any public authority having jurisdiction. Refer to General Conditions for additional information.

1.16 DEFINITIONS:

- A. "Furnish: Means to supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.
- B. "Install": Describes operations at project site including actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.
- C. "Provide": Means to furnish and Install, complete and ready for intended use.

2 PRODUCTS

2.01 MATERIAL:

- A. All materials and products used for construction shall be new, of the best grade, and latest products as listed in printed catalog data. All articles of a kind shall be the standard product of a single manufacturer. Trade names and manufacturers names denote a character and quality of equipment desired and shall not be construed as limiting competition.
- B. Asbestos: Do not use products made of or containing asbestos.

2.02 QUALITY ASSURANCE:

- A. Refer to Section 01640 Material and Equipment for information regarding available alternatives to materials and equipment specified herein. Product listings are for informational purposes only and establish a general standard of quality.
- B. Provide products which are compatible with other portions of the work and provide products with the proper and correct power and fuel burner characteristics and similar adaptations for the project.

2.03 INSPECTION:

- A. All work and materials are subject to field observation at any and all times by the Owner's Representative.
- B. The Contractor shall notify the Owner's Representative a minimum of two days prior to testing any piping system which must be witnessed and accepted before it is covered up or enclosed.
- C. If an observer finds any material or work not conforming to these Specifications, within three days after being notified, remove the materials from the premises and replace with approved materials. If the material has been installed, the entire expense of removing and replacing shall be borne of the Contractor.

3 EXECUTION

3.01 EQUIPMENT PROTECTION:

- A. Keep pipe, ductwork and conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect piping, conduit, ductwork, fixtures, equipment and apparatus against dirty water, chemical or mechanical damage both before and after installation. Restore damaged or contaminated fixtures, equipment or apparatus to original conditions or replace at no cost to the Owner.
- B. Protect bright finished shafts, bearing housings, and similar items until in service. No rust will be permitted.
- C. Cover or otherwise suitably protect equipment and materials stored on the job site.

3.02 CLEANING:

- A. General: Clean mechanical and plumbing equipment, fixtures, piping and ductwork of stampings and markings (except those required by codes), iron cuttings, and other refuse.
- B. Painted Surfaces: Clean scratched or marred painted surfaces of rust or other foreign mater and paint with matching color industrial enamel, except as otherwise noted.
- C. Before operating any equipment or systems, make thorough check to determine that systems have been flushed and cleaned as required and equipment has been properly installed, lubricated and serviced. Check factory instructions to see that installations have been made accordingly and that recommended lubricants have been used.

- D. Use particular care in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Check equipment for damage that may have occurred during shipment, after delivery or during installation. Repair damaged equipment as approved or replace with new equipment.

3.03 LAYOUT AND COORDINATION:

- A. Site Examination: Before starting work, carefully examine site and all contract Drawings so as to become thoroughly familiar with conditions governing work on this project. Verify all indicated elevations, building measurements, roughing-in dimensions and equipment locations before proceeding with any of the work.
- B. The existence of any wires, conduits, pipes, ducts or other service facilities are shown in a general way only. It will be the duty of the Contractor to visit the site and make exact determination of the existence of any such facilities prior to submitting a bid. It is understood that the Contractor will be responsible for making the exact determination of the location and condition of these facilities.
- C. The location of all utilities indicated on the plans is taken from existing public records. The exact location and elevation of all public utilities must be determined by the Contractor. It shall be the duty of the Contractor to ascertain whether any additional facilities other than those shown may be present.
- D. Sleeves, Insets, Cast-in-Place Work: provide sleeves, inserts, anchoring devices, cast-in-place work, etc. which must be set in concrete sequenced at the proper time for the project schedule.
- E. Coordination:
  - 1. Where the work must be sequenced and positioned with precision in order to fit into the available space, prepare accurate scale shop drawings showing the actual physical dimensions required for the installation and submit prior to purchase-fabrication-installation of any of the elements involved in the coordination.
  - 2. Cooperate with other trades in furnishing material and information for sleeves, bucks, chases, mountings, backing, foundations and wiring required for installation of mechanical items.
  - 3. Coordinate all work with other trades and determine in advance where interfacing of the mechanical work and other work are required to be connected together. Provide all materials and equipment to make those connections. Submit shop drawings showing required connections where special conditions exist.
- F. Discrepancies: Report immediately any error, conflict or discrepancy in Plans, Specifications and/or existing conditions. Do not proceed with any questionable items of work until clarification of same has been made. Should rearrangement or re-routing of ducts or piping be necessary, provide for approval the simplest layout possible for that particular portion of the work.

3.04 TEMPORARY FACILITIES AND CONTROLS:

- A. Comply with Division 1 requirements.

- B. Permanent mechanical systems' equipment utilized for temporary heating, ventilating and cooling shall be started with all controls and safeties installed and operational. Start-up shall be done by a factory approved mechanic only.
- C. Owner's warranties shall not be abridged by Contractor's use of the permanent systems' equipment prior to final acceptance. Warranty period shall begin at final completion.

3.05 MECHANICAL WORK CLOSEOUT:

- A. General: Refer to the Division 1 sections for general closeout requirements. Calibrate all equipment requiring same.
- B. Record Drawings: Submit record set of drawings required in Division 1, Submittals and as previously specified in this Section.
- C. Closeout Equipment/Systems Operations: Sequence operations properly so that work of project will not be damaged or endangered. Coordinate with seasonal requirements. Operate each item of equipment and each system in a test run of appropriate duration with the Architect present, and with the Owner's operating personnel present, to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance. Clean and lubricate each system, and replace dirty filters, excessively worn parts and similar expendable items of the work.
- D. Operation and Instruction: Provide eight (8) hours in blocks or time and/or days as defined by owner of on-site factory certified training to Owner's personnel on all VRF mechanical systems and equipment. Training shall include maintenance, lubrication, troubleshooting and repair. Contractor shall provide necessary written manuals and training aides explaining operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety and similar features of the installed system. Three (3) copies of written manuals shall be left with Owner at end of training.
- E. Close out costs: Include separate line items under Contractor and principal subcontracts for Project closeout in an amount totaling five percent (5%) of the contract sum and subcontract amounts.

END OF SECTION

1 GENERAL

1.01 SECTION INCLUDES:

- A. Items common to more than one section of Division 23 and general construction procedures and products. Work described in this Section applies to all Sections of Division 23.

1.02 STORAGE AND HANDLING:

- A. Deliver materials to the project site with manufacturer's labels intact and legible. Handle materials with care to avoid damage. Store materials inside protected from weather, dirt and construction dust. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping. Label equipment as soon as it arrives at job site.

1.03 SUBMITTALS:

- A. Submit product data under provisions of Section 23 0000 and Division 1.
- B. Provide submittals for:
  - 1. Motors.
  - 2. Starters.
  - 3. Pipe sleeves
  - 4. Escutcheons.
  - 5. Piping and Equipment Identification.
  - 6. Valve Schedule.
  - 7. Variable Frequency Drives

2 PRODUCTS

2.01 QUALITY ASSURANCE:

- A. Refer to Division 1 Material and Equipment for information regarding available alternatives to materials and equipment specified herein. Product listings are for informational purposes only and establish a general standard of quality.
- B. Provide products which are compatible with other portions of the work and provide products with the proper and correct power and fuel burner characteristics and similar adaptations for the project.

2.02 MATERIALS:

- A. All materials and products used for construction shall be new, of the best grade, and the latest products as listed in printed catalog data.
- B. All articles of a kind shall be the standard product of a single manufacturer.

- C. Provide products which are compatible with other portions of the work and products which have the proper electrical power and fuel-burning characteristics for this project.
- D. Trade names and manufacturers names denote the character and quality of equipment desired and shall not be construed as limiting competition.

2.03 ELECTRIC MOTORS:

- A. Enclosure Type: Open drip-proof for normal concealed indoor use, guarded where exposed to employees or occupants. Type II for outdoor use, except weather-protected Type I where adequately housed.
- B. Bearings: Ball or roller bearings, and design for thrust where applicable; permanent or pressure lubricated anti-friction. Sleeve-type bearings permitted only where indicated for light-duty fractional horsepower motors.
- C. Construction: General purpose, continuous duty; NEMA design "B", except "C" for high starting torque applications.
- D. Frames: For single phase motor sizes NEMA No. 48, except 56 for heavy-duty applications. NEMA "T" frames for 1 horsepower and larger polyphase motors.
- E. Phases and Current: 1/3 horsepower and smaller capacitor-start single-phase; 1/2 horsepower and larger, squirrel-cage induction polyphase. Coordinate with actual current characteristics; specified in Division 16 and do not use 230/460 voltage motors on 208 voltage power or vice versa.
- F. Service Factor: 1.35 for single-phase; 1.15 for polyphase.
- G. Overload Protection: Built-in thermal with internal sensing device for stopping motor, and for signaling where indicated on single phase motors.
- H. Speed: Not faster than synchronous speeds of 1800 RPM except where otherwise indicated.
- I. Temperature Rating: Class B insulation, except where otherwise indicated or required for service indicated.
- J. Starting Capability: As required for service indicated, but not less than 5 starts per hour.
- K. Efficiency: The manufacturer's highest efficiency motors tested under procedures recommended by NEMA Premium (IEEE Standard 112, Test Method B). Minimum 84% efficiency at 3 HP increasing to 90% above 15 HP. Submit manufacturer's data if motor nameplate does not indicate minimum efficiency.
- L. Manufacturers: Century, General Electric, Lincoln, Louis Allis, Baldor, Wagner, Westinghouse or accepted substitute. Where selection of motor manufacturer is within Contractor's control (independent of mechanical equipment selection), provide motors produced by a single manufacturer.
- M. VFD duty: Provide inverter type with shaft grounding rings.

2.04 STARTERS AND SWITCHES:

- A. General: Provide each motor with starter or switch as approved and recommended by manufacturer of motor or equipment of which motor is a part.
- B. Magnetic Starters: Provide for ½ horsepower and larger motors, and for smaller motors on automatic control or with interlock switch. Include pilot lights, reset, trip-free relay on each phase, Hand-Off-Auto switch in cover, and devices for coordination with control system (including transformer for control circuit, verify holding coil voltage requirements with control system design). Provide automatic ambient temperature compensation for starter heaters.
- C. Manual Switches: Provide on motors 1/3 horsepower and smaller except where automatic control or interlock is indicated. Include pilot light. Provide overload protection where not protected by panel board circuit breaker or fused disconnect switch.
- D. Starter Characteristics: Type I general purpose enclosure with padlock ears and mounting supports. Starter type and size as recommended by motor manufacturer.
- E. Manufacturers: General Electric, ITE, Allen Bradley, Cutler-Hammer, Square D or accepted substitute.

2.05 ELECTRICAL EQUIPMENT:

- A. Equipment Wiring: Interconnecting wiring within or on a piece of mechanical equipment shall be provided with the equipment unless required otherwise. Provide all necessary field wiring and devices from the point of connection indicated on the electrical drawings to each equipment item.
- B. Control Wiring: All control wiring for mechanical equipment shall be provided under Section 23 0923 or 23 0933, Controls and Instrumentation.
- C. Codes: All electrical equipment and products shall bear the U.L. and/or C.S.A. label as required by governing codes and ordinances. Refer to paragraph 1.3, Quality Assurance for definition of testing agency certification requirements.

2.06 DRIVES:

- A. General: "V" section belt drives, multiple as required, sized on 1.5 times installed motor horsepower. Provide variable pitch motor sheaves on all one or two belt drives and standard slide rails or approved means of adjustment for each motor with belt drive. Use standard section belts and no sheave smaller than cataloged industry standard; provide countersunk center on shaft ends to receive speed counter tip.
- B. Manufacturers: Dayton, Gates, Browning, or accepted substitute.

2.07 MACHINERY GUARDS:

- A. Furnish guards for protection on all rotating and moving parts of equipment. Provide guards for all metal fan drives and motor pulleys, regardless of being enclosed in a metal cabinet.

- B. Design guards so as not to restrict air flow at fan inlets resulting in reduced capacity. Provide 2-1/2 inches diameter access opening holes in guards for easy use of tachometers at pulley centers. Guards shall be easily removable for pulley adjustment or removal and changing of belts.
- C. All guards shall meet OSHA requirements including back plates.

2.08 ACCESS PANELS:

- A. Access panels shall have same fire rating as surface where mounted.
- B. Provide flush key cylinder locks on all access panels less than 8 feet above the floor in public spaces. Turn keys over to Owner at project completion. Screwdriver latches on all others.
- C. Steel, 24" x 24" or as required. Complete with steel frame, hinged locating door, and prime coat finish. Type to match building construction.
- D. Manufacturers: INRYCO/MILCOR Style DW, K or M panels as required by construction. Bilco, Potter-Roemer or accepted substitute.

2.09 PIPE SLEEVES:

- A. Interior Wall Sleeves: 12 gage galvanized steel, flush with wall on both sides.
- B. Interior Floor Sleeves: 12 gage galvanized steel and extend 2-inches above finished floor.
- C. Exterior Wall Sleeves: Cast iron, flush with wall on both sides.
- D. On Grade Floor Sleeves: Same as exterior wall sleeves.

2.10 ESCUTCHEONS:

- A. Brass material, chrome plated finish. Size sufficient to cover all pipe openings through wall, floor or ceiling. Set screw or spring to secure to pipe.

2.11 UNIONS:

- A. Steel pipe union shall be 150-pound malleable iron, brass to iron seat, ground joint, black or galvanized to match pipe.
- B. Copper pipe union shall be 200 psig working pressure. Bronze body. Solder ends.
- C. Insulating unions shall be 250 psig working pressure. Pipe ends and material to match piping. Electric current below 1% of galvanic current. Gasket material as recommended by manufacturer. Epco or approved.

2.12 ROOF FLASHING:

- A. Use flashing products specifically designed for and compatible with metal roofing system used.



2.13 MISCELLANEOUS STEEL:

- A. Provide steel as required for adequate support of all mechanical equipment, angle or channel, I or H sections as required by application. Provide suitable base plates for stands and anchors for hanging equipment. Drill support holes only in flanges of structural center of length as possible. Apply on coat of black rust inhibitive enamel primer to shop fabricated items before delivery to job; other painting as specified herein. Provide shop drawings of supports especially constructed for this project. Burning of holes is not permitted.

2.14 PAINTING:

- A. Apply one coat of black rustoleum primer to shop fabricated items before delivery to job. Other painting as specified herein.

2.15 IDENTIFICATION MARKERS:

A. Pipe Markers:

- 1. Adhesive pipe markers of width, letter size and background color conforming to Beaverton School District standards and to match existing pipe covers and labeling.
- 2. Acceptable Manufacturers: Brady B350 with banding tape. Seaton, Zeston, Porter or accepted substitute.

B. Nameplates:

- 1. Engraved nameplates, 1/16 inches thick, laminated 3-ply plastic, center ply white, outer ply black, letters formed by exposing center ply.
- 2. Size: 3 inches by 5 inches nameplates with 1/4-inch high letters.
- 3. Manufacturers: Lamicoid. Seaton, Brady, Zeston or accepted substitute.

C. Valve Tags:

- 1. 1-1/2 inches diameter, 18-gauge polished brass tags with 3/16-inch chain hole and 1/4-inch-high stamped, black-filled service designation.
- 2. Manufacturers: Seaton Style 250-BL, Brady, Zeston or accepted substitute.

D. Lettering and Graphics:

- 1. Coordinate names, abbreviations and other designations used in mechanical identification work with designations shown or scheduled. Provide numbers, lettering and wording as indicated for identification of mechanical systems and equipment.
- 2. Multiple Systems: Where multiple systems of same name are shown provide identification which indicates individual equipment number as well as service (examples: Chiller (CH) No. 1, Chiller (CH) No. 2, Air Conditioning Unit No. 1 (AC) No. 1, Air Conditioning Unit (AC) No. 2.)

2.16 VALVE SCHEDULES:

- A. Schedules: Valve schedule for each piping system, typewritten and reproduced on 8-1/2 by 11-inch paper. Indicate valve number, piping system, location of valve (room or space) and normal setting (open, closed, etc.). Mark valves which are intended for emergency shutoff and similar uses by special notation. In addition to mounted copies, furnish five (5) extra copies for maintenance manuals.

2.17 CONCRETE FOR MECHANICAL WORK:

- A. Provide strength classes per Building Code.

2.18 VARIABLE-FREQUENCY MOTOR CONTROLLERS:

- A. Acceptable Manufacturers: Allen Bradley, Robicon, ABB, Trane, Yasakawa, Siemens, Emerson Industrial Automation, or approved equal.
- B. General Description:
  - 1. AC motor variable frequency controller (VFC) shall be of pulse width modulated (PWM) inverter type. The VFC shall be designed to convert 60 Hz input power to adjustable frequency output power to provide positive speed control to standard induction motors. The VFC shall be dedicated variable torque design for specific use with centrifugal loads.
  - 2. Provide complete solid-state variable frequency power and logic unit.
  - 3. Frequency control shall be stepless throughout the range under variable torque load on a continuous basis. Frequency controlled by remote building energy management systems providing 4-20MA input signal to drive and remote start/stop signal. Coordinate with other work of Division 23.
  - 4. Provide adjustable frequency control with diode bridge/capacity input designed to provide high, constant power factor of 0.95 regardless of load or speed and eliminate SCR line noise.
  - 5. Each VFD shall contribute no more than 5 percent total harmonic voltage distortion at the VFD input terminals while operating under full-load conditions. If proposed VFD equipment is anticipated to exceed these limits, multi-pulse converters and/or harmonic filtering devices shall be provided.
  - 6. Equipment shall be designed and manufactured in accordance with applicable NEMA and IEEE recommendations and be designed for installation in accordance with NEC. Equipment shall have UL and/or CSA approval.
  - 7. Control shall be suitable for operation in ambient temperature of 0 to 40°C.
  - 8. Every VFD shall be factory tested with an AC induction motor 100 percent loaded and temperature cycles within an environmental chamber at 104°F.

C. Self Protection and Reliability Features:

1. Adjustable current limit from 60 to 110 percent of drive rating
2. Adjustable instantaneous over current trip.
3. Under voltage trip.
4. Over temperature trip.
5. Short circuit protection phase to phase and phase to ground faults phase rotation insensitive.
6. Momentary power loss, more than 17 milliseconds.
7. Transient protection against all normal transients and surges in incoming power line.
8. Orderly shutdown in event of any above conditions, drive shall be designed to shut down safely without component failure.
9. Provide visual indication and manual reset.

D. Standard Features:

1. Drive logic shall be microprocessor based. Control logic shall be isolated from power circuitry.
2. Standalone operation to facilitate startup and troubleshooting procedures.
3. VFD shall have a lockable circuit breaker disconnect and be UL 508c listed for use on distribution systems with 22,000 AIC.
4. Door interlock protection which shall be defeatable by qualified personnel to troubleshoot during operation as required.
5. Input power 460V 60Hz, 3-phase output voltages shall be equal to applied input voltage.
6. Isolated signal inputs.
7. Frequency Stability: Output frequency shall be held to +0.1 percent of maximum frequency regardless of load, +10 percent input voltage change or temperature changes within ambient specification.
8. Built-in digital display located in panel face shall indicate output frequency, voltage and current and shall provide indication of over current, over voltage, current limit, ground fault, over temperature, input power on, minimum or maximum speed adjustment, power on, and fault condition.
9. Start/Stop Control: Controlled decelerated stop.
10. Primary and secondary fused for a control circuit transformer.

11. Minimum and maximum speed control.
12. Adjustable Accel/ Decel: Independently adjustable 10-100 second.
13. Hands-off auto switches.
14. Programmable auto restart after power outage.
15. Fused disconnects shall include auxiliary contacts to isolate control circuit when disconnect is in "off" position.
16. Remote contacts for fault, and on/off status.
17. Adjustable motor output voltage.
18. Analog output voltage of 0-10 VDC, 4-20MA proportional to control output frequency.
19. RS232 communications port, and programming software capability.

E. Additional Features:

1. NEMA 1 enclosure shall isolate each motor starter and control section with its associated disconnect switch.
2. Manual speed control for each motor.
3. Manual bypass shall provide ability to service control while motor is operational.
4. Provide radio frequency and electromagnetic interference noise suppression network to limit radio frequency and electromagnetic interference.
5. Provide isolated analog output signals for volts, amps, and frequency, from each VFD for connection to the building energy management system.
6. Provide line (input) reactors.
7. Provide output filters for all VFD's located more than 150 conductor feet from the motor they serve.
8. VFD shall be designed to catch a spinning load in forward and reverse direction.
9. Harmonic calculations shall be performed on a manufacturer-supplied harmonic analysis program for conformance with IEEE 519.

3 EXECUTION

3.01 ACCESS PANELS:

- A. Furnish and install access panels required for mechanical work. Access panels shall have same fire ratings as surface where mounted. Furnish panels of adequate size for valves and equipment requiring service and installed above ceilings, behind walls or in furring, complete with correct frame for type of building construction involved. Exact size, number and location of access panels are not necessarily shown. Use no panel smaller than 12 inches by 12 inches for simple manual access or smaller than 16 inches by 20 inches where personnel must pass through. Paint with color and finish to match surrounding architectural features, where exposed.

3.02 PIPE SLEEVES:

- A. Sleeves: Large enough in diameter to provide ¼-inch clearance around pipes or insulation. Caulk with watertight rated, UL listed foam-in-place barrier.
- B. Layout: Lay out work in advance of pouring of slabs or construction of wall and furnish and set inserts and sleeves necessary to complete the work.
- C. Coordination: Cutting or patching required as a result of lack of coordination of this operation shall be at no change in contract amount.

3.03 FLOOR, WALL AND CEILING ESCUTCHEONS:

- A. Install on piping passing through finished walls, floors, ceilings, partitions and plaster furrings. Escutcheons shall completely cover opening around pipe.
- B. Secure wall and ceiling escutcheons to pipe or structure.
- C. Escutcheons shall not penetrate insulation vapor barriers.
- D. Escutcheons not required in mechanical rooms or unfinished spaces.

3.04 MECHANICAL EQUIPMENT WIRING:

- A. Provide all mechanical equipment motors, automatic temperature, limit, float and similar control devices required, with wiring complete from power source indicated on Electrical Drawings.
- B. Provide properly rated motor overload and under voltage protection and all manual or automatic motor operating devices for all mechanical equipment.
- C. Equipment and systems shown on the Drawings and/or specified, are based upon requirements of specific manufacturers which are intended as somewhat typical of several makes which may be approved. Provide all field wiring and/or devices necessary for a complete and operable system including controls for the actual selected equipment/system.
- D. Provide all starters for mechanical motors. Review Electrical Specifications and Drawings to determine which mechanical motor starters will be provided under the Electrical Specification Sections and provide all others.

3.05 PAINTING:

- A. General: Coordinate painting of mechanical equipment and items with products and methods specified under Section 09900, Painting.
- B. Painting Materials: material shall comply with Section 09900, Painting.
- C. Uninsulated Piping: Paint black or galvanized uninsulated piping located buried in ground, in concrete or masonry one (1) coat acid-resisting black paint. Paint black or galvanized uninsulated piping in moist equipment rooms, crawl spaces without vapor barriers or exposed to weather one (1) coat black asphaltum varnish.
- D. Iron Work: Paint hangers, rods, anchors, guides, threads of galvanized pipe, bases, supports, uncoated sheet metal and other iron work without factory finish, exposed to weather, located in moist concealed spaces and moist equipment rooms one coat acid-resisting black paint. Apply one (1) coat Dixon's Aluminum Graphite No. 209 paint over the (1) coat primer as recommended by paint manufacturer to all hot metal surfaces.
- E. Sheet Metal: Apply one coat of zinc chromate to mechanical sheet metal exposed to weather, except no painting required on aluminum or stainless steel. Apply one coat of flat black paint to the inside of unlined ducts behind all grilles and registers.
- F. Insulated Piping and Other Insulated Surfaces: Paint insulated piping in half-round, split tile, or other inaccessible locations, one (1) coat asphalt emulsion.

3.06 MECHANICAL SYSTEM IDENTIFICATION:

- A. Piping System: Indicate each pipe system by its generic name (abbreviated) as shown; except vent and drainage piping. Comply with ANSI A13.1 for marker locations, letter sizes, and colors. Include arrows to show direction of flow and "Electric Traced" signs to identify heat cable wrapped piping.
- B. Valve Identification: Tag all valves with brass disc and chain. Prepare valve charts indicating valve number, size, location, function and normal position. Use no duplicate numbers in Plumbing and Heating systems. Mount glazed frames containing one set of valve charts in the building as directed.
- C. Each new piece of equipment shall bear a permanently attached identification plate, listing the manufacturer's name, capacities, sizes and characteristics. In addition to the manufacturer's identification plate, provide nameplates of black phenolic resin laminate and identify new equipment by name and number ½" high letters.
- D. Mount valve schedule(s) as directed by Architect or Owner.

3.07 ACCESSIBILITY:

- A. Locate valves, thermometers, cleanout fittings and other indicating equipment or specialties requiring frequent reading, adjustments, inspection, repairs and removal or replacement conveniently and accessibly with reference to the finished building.

- B. Thermometers and Gages: Install thermometers and gages so as to be easily read from the floors, platforms and walkways.

3.08 INSTALLATION:

- A. Locating and Positioning Equipment: Comply with all Codes, Regulations and observe good common practice in locating and installing mechanical equipment and material so that completed installation presents the least possible hazard. Maintain adequate clearances for repair, service and operation to all equipment and comply with Code requirements. Set all equipment level or as recommended by manufacturer.
- B. Arrangement: Arrange ductwork and piping parallel with primary lines of the building construction, and with a minimum of 7' overhead clearance in all areas where possible. Conceal all piping and ductwork. Locate operating and control equipment properly to provide easy access. Give right-of-way to piping which must slope for drainage. Set all equipment level as recommended by manufacturer. Under no conditions shall beams, girders, footings or columns be cut for mechanical items. Casting of pipes into concrete is prohibited unless so shown on Drawings.
- C. Anchorage: Anchor and/or brace all mechanical equipment, piping and ductwork to resist displacement due to seismic action, include snubbers on equipment mounted on spring isolators.
- D. Drip Pans: Provide drip pans under all above ceiling in-line pumps and cooling coils. Locate pan immediately below piping and equipment and extend a minimum of 6 inches on each side and lengthwise 18 inches beyond equipment being protected. Fabricate pans 2 inches deep, or reinforced sheet metal (20-gauge copper, or 16-gauge steel with 2 ounces zinc finish hot dipped after fabrication) with rolled edges and soldered or welded seams. Provide 3/4-inch copper drainage piping, properly discharged to over floor drain or as shown on the Drawings. Comply with Mechanical Code overflow protection and pipe sizing.
- E. Adjusting: Adjust and calibrate all automatic mechanical equipment, mixing valves, flush valves, float devices, etc. Adjust flow rates at each piece of equipment or fixture.
- F. Building Vapor Barrier: Wherever the building insulation vapor barrier is penetrated by mechanical piping, hangers, conduits, ductwork, etc., provide clear self-adhesive tape recommended by the insulation manufacturer around the penetrations.

3.09 SYSTEM ADJUSTMENT:

- A. Adjust and calibrate all automatic mechanical equipment, mixing valves, float devices, etc. Adjust flow rates at each piece of equipment or fixture. Open and close all shutoff and control valves several times to insure tight glands.

3.10 CUTTING AND PATCHING:

- A. General: Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation of mechanical work. Do all necessary cutting and patching of existing yard surfaces required for completion of the mechanical work. Patch to match finish and color of adjacent surfaces.

END OF SECTION



1 GENERAL

1.01 WORK INCLUDED:

- A. Provide all pipe, piping fittings and all related components required for complete piping system. Refer to each specification section for each system for pipe application.

1.02 REFERENCES:

- A. ANSI/ASME Sec. 9 - Welding and Brazing Qualifications.
- B. ANSI/ASTM B32 - Solder Metal.
- C. ANSI/AWS D1.1 - Structural Welding Code.
- D. ASME - Boiler and Pressure Vessel Code.
- E. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- F. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
- G. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- H. AWS A5.8 - Brazing Filler Metal.
- I. AWWA C601 - Standard Methods for the Examination of Water and Waste Water.

1.03 QUALITY ASSURANCE:

- A. Conform to ANSI/ASME B31.9 for pressurized system as well as all applicable codes.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9. and ANSI/AWS D1.1.

1.04 SUBMITTALS:

- A. Submit product data under provisions of Section 23 0000 and Division 1.
- B. Include data on pipe materials, pipe fittings and accessories.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver products to site under provisions of Section 23 0000.
- B. Store and protect products under provisions of Section 23 0000 and provide factory applied end caps each length of pipe and tubes to prevent damage to pipe-ends and eliminate dirt and moisture from inside of pipes and tubes.

2 PRODUCTS

2.01 NATURAL GAS PIPING:

- A. Above Grade
  - 1. Galvanized Steel Pipe: Threaded or Mega Press fittings.
- B. Coiling: PE Pipe and tubing shall be furnished in coils. The amount of footage per coil shall be as specified below unless otherwise specified on the purchase order. Each coil shall consist of a single length of pipe. Joints shall not be permitted. 4" IPS, and 6" IPS PE pipe shall be furnished in straight lengths 40 feet long. A straight length shall consist of a single length of pipe. Joints will not be permitted.
- C. Fittings: ASTM D2513 socket type. Joints: fusion welded. Provide minimum 14-gauge single strand, copper wire with orange color insulating coating.

2.02 HEATING WATER:

- A. Steel Pipe: ASTM A53 or A120, Schedule 40, black. Fittings: ANSI/ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings. Joints: Screwed for pipe 2 inches and under, or ANSI/AWS D1.1, welded for pipe over 2 inches.
- B. Copper Tubing: ASTM B88, Type L, hard drawn. Fittings: ANSI/ASTM B16.22 cast brass or ANSI/ASME B16.29 solder wrought copper. Joints: ASTM B32, Grade 95TA or ANSI/AWS A5.8, BCuP silver braze. Brazed for pipe 2 inches and over, soldered for pipe under 2 inches.
- C. At contractor's option with no additional cost to owner: for sizes larger than 3 inch, cut grooved black steel pipe with Victaulic style 77 couplings with grade "E" gaskets and appropriate fittings. Type "L" copper Victaulic approved as optional material.

2.03 EQUIPMENT AND COOLING COIL DRAINS AND OVERFLOWS:

- A. Copper Tubing: ASTM B88, Type L, hard drawn. Fittings: ANSI/ASTM B16.22, cast brass, or ANSI/ASME B16.29 solder wrought copper. Joints: ASTM B32, solder, Grade 95TA or ANSI/AWS A5.8, BCuP silver braze.

2.04 MISCELLANEOUS PIPING MATERIAL:

- A. Welding Materials: Provide welding materials as determined by the installer to comply with installation requirements. Comply with Section 2-C, ASME Boiler Code for welding materials.
- B. Soldering and Brazing Materials: Provide soldering materials as determined by the installer to comply with installation requirements.
  - 1. Tin-Antimony Solder: ASTM B32, Grade 95TA.
  - 2. Lead-Free Solder: ASTM B32, Grade HB. Harris "Bridgit" approved.
  - 3. Silver Solder: ASTM B32, Grade 96.5TS.

- C. Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast-iron flanges; raised-face for steel flanges. Pressure and temperature rating required for the service indicated.
- D. Sleeve Seal: Rubber-link pipe wall and casing closure. Thunderline Link-Seal. For fire rated wall, floor or ceiling penetrations, 3-M "CP-25" caulk, "No. 303" putty and/or "PSS 7904" sealing system.
- E. Tracer Wire: 14-gauge, single strand, copper wire with blue insulation for water, green for sanitary and storm sewers, and orange for gas. 3M "DBY" direct bury splice kit required at all splices.

2.05 FLANGES, UNIONS, AND COUPLINGS:

- A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
- B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; neoprene gaskets for gas service; 1/16-inch-thick performed neoprene bonded to asbestos.
- C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; "C" shape composition sealing gasket; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier. Victaulic "Clear Flow", Epco or accepted substitute.

2.06 PIPE SLEEVES:

- A. Minimum 20-gauge galvanized steel in concrete, 18 gauge in all other construction. Provide 1/2-inch clearance around pipe or insulation. Provide UL approved fire-rated assemblies/caulking. 3M or accepted substitute.

2.07 ESCUTCHEONS

- A. Brass material, chrome plated finish. Size to cover all pipe openings through wall, floor or ceiling. Set screw or spring to secure pipe. Coordinate all opening sizes.

3 EXECUTION

3.01 PREPARATION:

- A. Ream pipe and tube ends. Remove burrs or 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. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

- B. Route piping in orderly manner, maintain gradient and conceal all piping unless otherwise indicated.
- C. Install piping to conserve building space, not to interfere with use of space or access panels and parallel with walls.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Provide loops, swing joints, pinchers, runouts and spring pieces to prevent damage to piping or equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Where piping is installed in the exterior building envelope or in any component of the exterior building envelope it shall be located on the warm building interior side of the building envelope insulation.
- H. Slope water piping and arrange to drain at low points and provide drain valve.
- I. Establish elevations of buried water piping outside the building to ensure not less than 3 feet of cover.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- K. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Section 23 0500.
- L. Establish invert elevations, slopes for drainage to 1/4 inch per foot minimum. Maintain gradients.
- M. Pitch vent piping at 1/4 inch per 10 feet minimum.
- N. Establish elevations of all heating and cooling piping to ensure minimum of 1-inch pitch for every 40 feet to low point drip or drains.
- O. Unions and Flanges: At all equipment to permit dismantling and elsewhere as consistent with good installation practice.
- P. Tracer Wire: Provide tracer wire as close to underground non-metallic water, sanitary and storm sewers and gas pipe in the trench as possible. Tracer wire shall be accessible at grade via all services, valve and meter boxes, curb cocks, cleanouts at the building, manholes (inside the cover near the top), etc. Locate all points on the record as-installed drawings. Splice into utility tracer system where available. Comply with code requirements.
- Q. Corrosion Control Underground Steel Piping Corrosion Protection: Factory wrap all uninsulated underground steel piping systems with protective coating composed of a coal-tar saturated wrapping tape over a 20-mil thick coal-tar epoxy coating. Wrap joints with a minimum of 1/2 width of wrap. Extend wrap not less than 4-inches above grade.
- R. Pipe Sleeves: Lay out work in advance of pouring concrete and furnish and set sleeves necessary to complete work.

1. Floor Sleeves: Provide sleeves on pipes passing through concrete construction. Extend sleeve 2-inches above finished floor. Caulk all pipes passing through floor with nonshrinking grout or approved caulking compound. Provide Link-Seal sleeve sealing system for slab on grade. Caulk/seal all piping passing through fire rated building assemblies with UL rated assemblies. Provide fire-rated assemblies per local code requirements.
2. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk all pipes passing through walls with nonshrinking caulking compound. Caulk/seal all piping passing through fire rated building assemblies with UL rated assemblies. Provide fire-rated assemblies per local code requirements.
- S. Expansion and Flexibility: Install all work with due regard for expansion and contraction to prevent damage to piping, ductwork, equipment, building and its contents. Provide piping offsets, loops, approved type expansion joints, anchors or other means to control piping movement and to minimize pipe forces.
- T. Escutcheons: Install on all exposed pipes passing through wall or floors and on fixture stops and waste connections to wall.

3.03 CLEANING:

- A. General: Clean all dirt and construction dust and debris from all mechanical piping systems and leave in a new condition. Touch up paint where necessary.
- B. Gas Piping: Blow clear of debris with nitrogen or oil free air. Clean all low point strainers and pockets.
- C. Heating Water System:
  1. Use one pound of trisodium phosphate per 50 gallons in the system, or one pound of sodium carbonate for each 30 gallons in the system or one pound of sodium hydroxide (lye) for each 50 gallons in the system.
  2. Fill, vent and circulate the system with this solution at design operating temperature. After circulating for four hours, drain and fill with fresh water including glycol.
  3. Test for pH and add sufficient amount of the cleaning chemical to obtain a pH between 7 and 8.
  4. Clean all strainers and remove start-up strainers (from suction diffusers) after the system has operated for one week.

3.04 TEST:

- A. Natural Gas Piping: One half hour minimum air at 60 psig for 2 psig gas, and 15 minutes at 10 psig for 7-inch water gauge natural gas or as approved and certified by serving utility.
- B. Heating Water Piping: 75 psig hydrostatic for 30 psig systems without loss for four hours.

END OF SECTION

1 GENERAL

1.01 WORK INCLUDED:

- A. The requirements of this Section apply to the valving for the systems specified elsewhere in Division 23.

1.02 QUALITY ASSURANCE:

- A. Provide valves from a single manufacturer where possible with manufacturer's name and pressure rating marked on valve body.
- B. All castings used for valve bodies shall be date stamped for quality assurance and traceability.
- C. Valve size shall be the same as connecting pipe size unless otherwise noted.
- D. Grooved end valves shall be of the same manufacturer as the adjoining couplings.

1.03 SUBMITTALS:

- A. Submit product data under provisions of Section 23 0000.
- B. Include data on valves and accessories.

2 PRODUCTS

2.01 BALL, CHECK, STOP CHECK, NON-SLAM CHECK, BUTTERFLY, GATE, GLOBE, LUBRICATED PLUG VALVE TYPES:

- A. A. Manufacturers: Crane, ITT, Grinnell, Hammond, Jenkins, Kennedy, Mueller, Lunkenheim, Milwaukee, Nibco, Powell, Apollo, Stockham, Walworth, Legend or accepted substitute. Grooved end valves Victaulic, Gustin-Bacon or accepted substitute. Victaulic (grooved end) and Grinnell (screwed/flanged) numbers are given except as noted.
- B. Heating Water System:
  - 1. Valves 2 inches and smaller:
    - a. Ball:
      - 1) (<230 deg. F) Victaulic Series 589 (brass body, standard port) and 569 (stainless steel body, full port), 300 psi.
      - 2) (<200 deg. F), Fig. 3500 (for hot water only). 125 psi, bronze body, full port.
    - b. Check, Fig. 3300. Class 125, bronze body, horizontal swing.
    - c. Gate, Fig. 3050. 150 psi, bronze body, non-rising stem.
    - d. Globe, Fig. 3240. 150 psi, bronze body.

2. Valves 2-1/2 inches and larger:
  - a. Butterfly: Stem shall be offset from the disc centerline to provide full 360-degree circumferential seating.
    - 1) (<250 deg. F), Victaulic MasterSeal (pressure responsive seat) / AGS-Vic300 (disc mounted seal); 300 psi ductile iron body.
    - 2) (<200 deg. F), Fig. 8000 (for hot water only). 150 psi cast iron body.
  - b. Check:
    - 1) Victaulic Series 716 (300 psi) and Series W715 (230 psi), ductile iron body, horizontal or vertical, with stainless steel spring.
    - 2) Fig. 6300 A. Class 125 cast iron body, horizontal swing.
  - c. Gate, Fig. 6020 A. Class 125, cast iron body, non-rising stem.
  - d. Globe, Fig. 6200 A. Class 125, cast iron body, renewable seat, bronze mounted.

C. Natural Gas:

1. 5 psig or less, 2 inches and smaller ball valves, Watts 6000UL. Threaded, 250 psi, 2-piece, bronze.
2. 5 psig or less, 2-1/2 inches and larger, 125 psi, all bronze or cast-iron body/bronze trim. AGA approved.

2.02 RELIEF VALVES:

- A. Bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.
- B. Manufacturers: Cash-Acme, Fisher, Foster, Spence, Watts or accepted substitute.

2.03 GAS PRESSURE REGULATORS (INCLUDE IF NOT IN DIV 22):

- A. Size and capacity as required for connected load. Style and model as approved by gas supplier.
- B. Manufacturers: Maxitrol, Rockwell, Fisher, Reliance, or accepted substitute.

2.04 WATER BALANCING VALVE:

- A. Balancing fitting with differential pressure taps, flow setting indicating pointer, brass or bronze body and trim with orifice flow restriction. 300 psi rated.



- B. Manufacturers: Victaulic/Tour Anderson, B&G "Circuit Setter", Taco, Armstrong, Thrush, Wheatley, Flow Design or accepted substitute. At contractor's option, balancing valves 3 inches and larger may be butterfly style, Victaulic MasterSeal, Jenkins No. 222 EL or accepted substitute as specified in Section 23 0500.
- C. Packaged coil components consisting of required coil valving, strainers, unions, hoses, etc., may be supplied. Victaulic Koil-Kit Series 799 or 79V, with Series 78U Union Port Fitting, Series 78Y Strainer/Ball Valve, Series 78T Union/Ball Valve, required braided hoses, and Series 793/794 Differential Pressure Controllers. The coil packaged shall be provided with a meter to be left with the owner after installation.

2.05 VALVE OPERATORS:

- A. Butterfly Valve Operators: Locking lever for shut-off service; "Memory Stop" for lever handle and slotted index plate for infinite number of settings for throttling service; gear operator with babbitt sprocket rim for chain operated valves and gear operators on all 6 inches or larger valves.
- B. Butterfly Valve Style: Grooved end type or lug type with cap screws for all valves utilized for equipment isolation for servicing.

3 EXECUTION

3.01 INSTALLATION:

- A. Provide clearance for installation of insulation and access to valves and fittings.
- B. Provide access where valves and fittings are not exposed. Coordinate size and location of access door with Section 23 0500.
- C. Install valves with stems upright or horizontal, not inverted.
- D. Provide one plug cock wrench for every five plug cocks sized 2 inches and smaller. Provide each plug cock sized 2-1/2 inches and larger with a wrench with set screw.
- E. Lubricant-Seal: Select and install plug valves with lubricant-seal except where frequent usage is indicated or can be reasonably expected to occur.
- F. Grooved joint valves shall be installed in accordance with the manufacturer's latest published installation instructions. The seat material shall be suitable for the intended service. The coupling manufacturer's factory-trained representative shall provide on-site training for the contractor's field personnel in the proper use of grooving tools and installation of grooved joint products. The representative shall periodically visit the job site to ensure best practices in grooved joint installations are being followed. (A distributor's representative is not qualified to conduct the training.)
- G. Fluid Control: Install gate, ball, globe, plug, and butterfly valves to comply with ANSI B31. Install check valves where indicated and where flow reversal is obviously not desirable and can be reasonably expected to occur, including piping at the discharge of pumps. Install silent check valves where necessary to eliminate water hammer occurring from reversal of flow.
- H. Application: Valve type and style as shown on the Drawings. Where style is not indicated, use the following:

1. Heating/Chilled Water: Use gate valves in mechanical and/or boiler rooms and globe valves for throttling service. For temperatures up to 230 deg. F, ball and butterfly valves may be used with lever operators with infinite number of settings up to 4-inch sizes and gear operator with setting indicator on larger sizes.
2. Use non-rising stem gate valves.

END OF SECTION

1 GENERAL

1.01 WORK INCLUDED:

- A. Provide pipe and equipment hanger, support, anchors and all related items for complete systems.

1.02 QUALITY ASSURANCE:

- A. Provide pre-manufactured horizontal piping and ductwork hangers, clamps, hanger rod, shields, supports, etc.
- B. Seismic requirements: Provide seismic restraints in accord with the latest edition of "Seismic Restraint Manual Guidelines" as published by SMACNA. Seismic Hazard Level (SHL) of "A". A lower SHL will be allowed provided the contractor provides calculations stamped by a registered professional structural engineering in the state the project is located indicating a lower SHL is acceptable.

1.03 SUBMITTALS:

- A. Submit product data under provisions of Section 23 0500.
- B. Submit construction details, and performance characteristics for each type and size of anchor, hanger and support.

2 PRODUCTS

2.01 HANGERS AND SUPPORTS:

- A. Listed Types: The Manufacturers Standardization Society (MSS) Piping Types listed with Grinnell figure numbers in parentheses where applicable (or other manufacturers as noted). ITT Grinnell, Elcen, Michigan, Super Strut, Kindorf, Unistrut or accepted substitute.
- B. Horizontal Piping Hangers and Supports:
  - 1. Adjustable Clevis Hanger: MSS Type 1 (Fig. 260).
  - 2. Adjustable Band Hanger: MSS Type 7 (Fig. 97), fabricated from steel.
  - 3. Adjustable Swivel-Band Hanger: MSS Type 10 (Fig.70).
  - 4. Clamp: MSS Type 4 (Fig. 212, 216).
  - 5. Double-Bolt Clamp: MSS Type 3 (Fig. 295A, 295H), including pipe spacers.
  - 6. Pipe Anchors: (Carpenter & Peterson Fig. 145CI) Steel weld type to pipe for sizes up to 20 inches in diameter.
  - 7. Single-Roll Support: MSS Type 42 (Fig. 174), including axle-roller and threaded sockets.
  - 8. Adjustable Roller Hanger: MSS Type 43 (Fig. 181), including axle-roller and clevis.

9. Adjustable Roll/Base: MSS Type 46 (Fig. 274), including roller, adjustable base and stand.
10. Rollers for Channel Support Systems: Grinnell Fig. 1901, 1902, 1911, 815, or 816 for pipe sizes up to 18 inches in diameter.
11. Sliding Support Base: MSS Type 35 (Grinnell 600 series). Base and guide.
12. Adjustable Saddle-Support: MSS Type 36 (Fig. 258) and MSS Type 37 (Fig. 259), including saddle, pipe and reducer. Fabricate base-support from steel pipe and include cast-iron flange or welded-steel plate.

C. Equipment and Piping Supports

1. Channel Support System: Galvanized, 12-gauge channel and bracket support systems, single or double channel as indicated on the Drawings or as required by piping and equipment weights. Grinnell "Power Strut" channel.
2. Steel Brackets: Welded structural steel shapes complying with one of the following:
  - a. Light Duty: MSS Type 31 (Fig. 194).
  - b. Medium Duty: MSS Type 32 (Fig. 195).
  - c. Heavy Duty: MSS Type 33 (Fig. 199).

D. Vertical Pipe Clamps

1. Two-Bolt Riser Clamp: MSS Type 8 (Fig. 261).
2. Four-Bolt Riser Clamp: MSS Type 42 include pipe spacers at inner bolt-holes.

E. Hanger Rod Attachment

1. Hanger Rod: Right hand threaded, (Grinnell Fig. 140 or 146 for all sizes).
2. Turnbuckles: MSS Type 13 (Fig. 230).
3. Weldless Eye-Nut: MSS Type 17 (Fig. 290).
4. Malleable Eye-Socket: MSS Type 16 (Fig. 110R).
5. Clevises: MSS Type 14 (Fig. 299).

F. Building Attachments

1. Concrete Inserts: MSS Type 18 (Fig. 282), steel or Grinnell Power-Strut PS349 continuous channel.
2. Clamps: MSS Type 19 (Fig. 285, 281), Type 20, 21 (Fig. 225, 226, 131), Type 23 (Fig. 86, 87, 88), Type 25 (Fig. 227), Type 27 through 30 where applicable.

2.02 SADDLES AND SHIELDS:

- A. Listed Types: The Manufacturers Standardization Society (MSS) Piping Types listed with Grinnell figure numbers in parentheses where applicable (or other manufacturers as noted).
- B. Protection Saddles: MSS Type 39 (Fig. 160).
- C. Protection Shields: MSS Type 40 (Fig. 167).
- D. Pre-insulated Pipe Supports: Pipe Shields Inc. or accepted substitute.
  - 1. Pipe supported on rods - Model A1000, through A4000 and A9000.
  - 2. Pipe supported on flat surfaces - Model A1000, A2000, A5000 through A7000.
  - 3. Pipe supported on pipe rolls - Model A3000 through A6000 and A8000.

2.03 MISCELLANEOUS HANGER MATERIALS:

- A. Metal Framing: Provide products complying with NEMA STD ML 1.
- B. Steel Plates, Shapes and Bars: ASTM A-36.
- C. Cement Grout: Portland Cement (ASTM C-150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C-404, Size No. 2). Mix at a ratio of 1.0-part cement to 3.0 parts sand, by volume with only the minimum amount of water required for placement and hydration.
- D. Heavy Duty Steel Trapezes: Fabricate from steel shapes selected for the loads required; weld steel in accordance with AWS Standards.
- E. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to the pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of the length recommended by the manufacturer to allow indicated travel.
- F. Standard Bolts and Nuts: ASTM A 307, Grade A.
- G. Concrete Anchors: Rawl Lok/Bolt, Hilti "HSL," ITT Phillips, Red Head Wedge Anchors, Ramset Trubolt or Dynabolt or accepted substitute.
- H. Shop Primer: Manufacturer's standard rust inhibitive primer.

2.04 ROOF EQUIPMENT SUPPORTS:

- A. General: Coordinate the location and type of each roof equipment support with the roofing system supplier. Systems to maintain roof warranty. Minimum 18-gauge galvanized steel with fully mitered and welded corners, internal bulkhead reinforcing, integral base plates, pressure-treated wood nailer and 18-gauge galvanized steel counterflashing. Compensate for roof slope so top of support is level. Construct curb to meet or exceed all seismic forces.

- B. Manufacturers: Thycurb, Custom Curb, Vibrex or accepted substitute.

3 EXECUTION

3.01 INSTALLATION OF HANGERS AND SUPPORTS:

- A. General: Proceed with the installation of hangers, supports and anchors only after the required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) the proper placement of inserts, anchors and other building structural attachments.
1. Install hangers, supports, clamps, and attachments to support piping and equipment properly from the building structure. Use no wire or perforated metal to support piping, and no supports from other piping or equipment. For exposed continuous pipe runs, install hangers and supports of the same type and style as installed for adjacent similar piping.
  2. Prevent electrolysis in the support of copper tubing by the use of hangers and supports which are copper plated, or by other recognized industry methods.
  3. Arrange supports to prevent eccentric loading of joists and joist girders. Locate supports at panel points only.
  4. Install hangers and supports to provide the indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded. Comply with the following installation requirements:
    - a. Clamps: Attach clamps, including spacers (if any), to piping outside the insulated piping support. Do not exceed pipe stresses allowed by ANSI B31.
    - b. Insulated Pipe Supports: Insulated pipe supports shall be supplied and installed on all insulated pipe and tubing.
    - c. Load Rating: All insulated pipe supports shall be load rated by the manufacturer based upon testing and analysis in conformance with ASME B31.1, MSS SP-58, MSS SP-69 and MSS SP-89.
    - d. Support Type: Manufacturer's recommendations, hanger style and load shall determine support type.
    - e. Insulated Piping Supports: Where insulated piping with continuous vapor barrier or where exposed to view in finished areas is specified, install hard maple wood insulation shields (Elcen Fig. 216) or steel pipe covering protection shields (MSS type 39) at each hanger.
- B. Provisions for Movement:
1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units.

2. Install hangers and supports so that equipment and piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

C. Pipe Hangers and Supports:

1. Vertical Spacing: Support at base, every floor height not exceeding 10 feet and required by Code and just below roof line.
2. Screwed or Welded Steel or Copper Piping: Maximum hanger spacing shall be as follows:

	Steel	Copper
1-1/4 inches and smaller	6-foot span	5-foot span
1-1/2-inch pipe	9-foot span	6-foot span
2-inch pipe	10-foot span	10-foot span
2-1/2-inch	11-foot span	10-foot span
4 inches and larger	12-foot span	10-foot span

3. Cast Iron Soil Pipe:
  - a. Hubless and Compression Joint: At every other joint except when developed length exceeds 4 feet, then at each joint.
  - b. Additional Support: Provide at each horizontal branch and/or at concentrated loads to maintain alignment and prevent sagging.
4. Install additional hangers or supports at concentrated loads such as pumps, valves, etc. to maintain alignment and prevent sagging.
5. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
6. Place a hanger within 12 inches of each horizontal elbow.
7. Support Rod: Hanger support rods sized as follows:

Pipe Size	Rod Diameter	Max. Load
2 inches and smaller	3/8-inch	610 lb.
2-1/2 to 3 inches	1/2-inch	1130 lb.
4 inches	5/8-inch	1810 lb.
6 inches	3/4-inch	2710 lb.
8 through 12 inches	7/8-inch	3770 lb.

- D. Adjust hangers and supports to bring piping to proper levels and elevations.
- E. Provide all necessary structural attachments such as anchors, beam clamps, hanger flanges and brackets in accordance with MSS SP-69. Attachments to beams wherever possible. Supports suspended from other piping, equipment, metal decking, etc., are not acceptable.

- F. Horizontal banks of piping may be supported on common steel channel member spaced not more than the shortest allowable span required on the individual pipe. Maintain piping at its relative lateral position using clamps or clips. Allow lines subject to thermal expansion to roll axially or slide. Size channel struts for piping weights.

3.02 INSTALLATION OF ANCHORS:

- A. Install anchors at the proper locations to prevent stresses from exceeding those permitted by ANSI B31, where recommended in SMACNA "Seismic Restraint Manual" or exceeding manufacturer's recommended loading, and to prevent the transfer of loading and stresses to connected equipment.
- B. Welding: Provide anchor by welding steel shapes, plates and bars to the piping and/or equipment and to the structure. Comply with ANSI B31 and AWS standards and SMACNA "Seismic Restraint Manual."
- C. Bolting: Provide standard plate washers under heads and nuts of bolts bearing on wood. Soap threads of lag bolts prior to installing.
- D. Structural Blocking: Locate as indicated and as required to support mechanical piping and equipment.
- E. Where expansion compensators are indicated, install anchors in accordance with the expansion unit manufacturer's written instructions, to limit movement of piping and forces to the maximums recommended by the manufacturer of each unit.
- F. Anchor Spacings: Install anchors at the ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for presetting of anchors as required to accommodate both expansion and contraction of piping.
- G. Painting: Refer to Section 23 0500.

3.03 ROOF EQUIPMENT SUPPORTS, EQUIPMENT CURBS AND PIPE CURB ASSEMBLIES:

- A. Provide prefabricated units for all roof penetrations for mechanical equipment. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated slope built into curb.
- B. Equipment supports: Provide for roof mounted equipment which does not require a structural roof deck penetration.
- C. Equipment Curbs: Provide for equipment which requires a structural roof deck penetration other than piping or conduit.
- D. Pipe Curb Assemblies: Provide for piping and electrical conduit which penetrates the roof deck to service equipment above the roof.

END OF SECTION



1 GENERAL

1.01 WORK INCLUDED:

- A. After completion of the work of installation, test and regulate all components of the heating, air conditioning and ventilating systems to verify air and water flow rates shown.
- B. Testing, adjustment, and balancing of air and water systems.
- C. Measurement of final operating condition of mechanical systems.

1.02 REFERENCES:

- A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. ASHRAE – Measurements, Instruments and Testing, Adjusting and Balancing.
- C. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.03 QUALITY ASSURANCE:

- A. Agency shall be company specializing in the adjusting and balancing of systems specified in this Section with minimum five years documented experience.
- B. Testing, adjusting and balancing shall be performed by a firm with 10 years of experience and certified for direct digital control systems.

1.04 SUBMITTALS:

- A. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- B. Submit test reports as a submittal under provisions of Section 23 0000.
- C. Prior to commencing work, submit draft reports indicating adjusting, balancing, and equipment data required.
- D. 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.
- E. 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.

2 PRODUCTS

2.01 EQUIPMENT:

- A. Provide all necessary personnel, equipment and services.

2.02 REPORT FORMS:

- A. Submit reports on forms.
- B. Forms shall include the following information:
  - 1. Title Page:
    - a. Company name.
    - b. Company address.
    - c. Company telephone number.
    - d. Project name.
    - e. Project location.
    - f. Project Architect.
    - g. Project Engineer.
    - h. Project Contractor.
    - i. Project altitude.
    - j. Outdoor conditions.
  - 2. Instrument List:
    - a. Instrument.
    - b. Manufacturer.
    - c. Model.
    - d. Serial number.
    - e. Range.
    - f. Calibration date.
  - 3. Air Handling Units, Exhaust Fans, Unit Ventilators and Fan Coil Units:
    - a. Location.
    - b. Manufacturer.
    - c. Model.
    - d. Supply air flow specified and actual.
    - e. Return and/or outside air flows, specified and actual.
    - f. Total and external static pressure specified and actual.

- g. Inlet pressure.
  - h. Discharge pressure.
  - i. Fan RPM.
  - j. Cooling and heating coils inlet/outlet water and air temperature including flow rates.
4. Air Flow:
- a. Identification/ location.
  - b. Design air flow.
  - c. Actual air flow.
  - d. Supply air temperature.
  - e. Return air temperature.
5. Heating Water (all coils):
- a. Identification/location.
  - b. Design water flow rate.
  - c. Actual water flow rate.
  - d. Entering temperature, specified and actual.
  - e. Leaving temperature, specified and actual.
  - f. Design and actual air flow rate.
6. Electric Motors and VFD's:
- a. Manufacturer.
  - b. HP/BHP.
  - c. Phase, voltage, amperage; nameplate, and actual.
  - d. RPM.
  - e. Service factor.
  - f. Starter size, rating, heater elements.
7. V-Belt Drive:
- a. Identification/location.
  - b. Required driven RPM.

- c. Driven sheave, diameter and RPM.
  - d. Belt, size and quantity.
  - e. Motor sheave, diameter and RPM.
  - f. Center to center distance, maximum, minimum, and actual.
8. Pumps:
- a. Identification/number.
  - b. Manufacturer.
  - c. Size/model.
  - d. Impeller.
  - e. Type of service system.
  - f. Design flow rate, pressure drop, BHP.
  - g. Actual flow rate, pressure drop, BHP.
  - h. Shut off, discharge and suction pressures.
9. Boilers:
- a. Manufacturer.
  - b. Model.
  - c. Input firing rate, MBH.
  - d. Rated output, MBH.
  - e. Water flow, design and actual.
  - f. Water pressure drop.
  - g. Water temperature, supply and return.

### 3 EXECUTION

#### 3.01 EXAMINATION:

- A. Before commencing work, verify that systems are complete and operable. Ensure the following:
  - 1. Equipment is operable and 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. Correct fan rotation.
  7. Fire and volume dampers are in place and open.
  8. Coil fins have been 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 has been minimized.
- B. Report any defects or deficiencies noted during performance of services to Architect.
- C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- E. Beginning of work means acceptance of existing conditions.

3.02 PREPARATION:

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

3.03 INSTALLATION TOLERANCES:

- A. Adjust air handling systems to plus or minus 10 percent for supply, return and exhaust systems from figures indicated.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.04 ADJUSTING:

- A. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- B. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

- C. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.05 AIR SYSTEM PROCEDURE:

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- 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.
- 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.
- M. Test and record entering and leaving air dry-bulb temperature for both heating and cooling cycles of each fan system.

3.06 WATER SYSTEM PROCEDURES:

- A. Adjust water systems to provide required or design quantities. Use calibrated orifices or other metered fittings and pressure gauges to determine flow rates for system balance.
- B. Adjust systems to provide specified pressure drops and flows through heat transfer elements. Perform balancing by measurement of temperature differential.

- C. Effect system balance with automatic control valves fully open.
- D. Effect adjustment of water distribution systems by means of balancing valves, valves and fittings. Do not use service or shutoff valves for balancing.

3.07 DOMESTIC WATER:

- A. Test and adjust domestic water recirculation system to ensure hot water circulation in all mains.

3.08 VERIFICATION OF CONTRACTOR'S PERFORMANCE:

- A. Balancing data may be spot checked with instruments similar to that used by the balancing firm.
- B. If there are discrepancies between balancing data and spot check data, readjust and rebalance the systems at no additional project cost.

END OF SECTION

1 GENERAL

1.01 WORK INCLUDED:

- A. Provide piping, ductwork and equipment insulation including jacketing, adhesive and all related accessories for complete insulated system.

1.02 QUALITY ASSURANCE:

- A. Applicator: Company specializing in piping insulation application with three years minimum experience.
- B. Insulation, Jacket and all Related Materials: Flame spread rating of 25 and smoke developed rating of 50.
- C. Codes: Comply with all applicable codes.
- D. Installation: Install in accordance with Manufacturer's recommendations.
- E. Prohibited substances: The following substances are prohibited in the State of Oregon for use in manufacturing duct insulation, wraps, or covers and pipe insulation, wraps or covers. Products containing these substances are not allowed for use.
  - 1. Pentabrominated diphenyl ether CAS#32534-81-9.
  - 2. Octobrominated diphenyl ether CAS#32536-52-0.
  - 3. Decabrominated dphenyl ether CAS#1163-19-5.

1.03 SUBMITTALS:

- A. Submit product data and installation instructions under provisions of Section 23 0000.
- B. Include product description, list of materials and thickness for each service, and locations.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Deliver product to site under provisions of Section 23 0000.
- B. Store and protect product under provisions of Section 23 0000.
- C. Store insulation in original shipping container with labeling in place. Do not install damaged insulation.

1.05 FIRE HAZARD CLASSIFICATION:

- A. Maximum fire hazard classification of the composite insulation to be not more than a flame spread of 25, fuel contributed of 50 and smoke developed of 50 as tested by ASTM E84, NFPA 255 and UL 723 method.



- B. Test pipe insulation in accordance with the requirements of UL "Pipe and Equipment Coverings R5583 400 8.15.", ASTM C1136 and ASTM C547.
- C. Test duct insulation in accordance with ASTM E84 and ASTM C1071 and bear the UL label.

1.06 LINING MATERIALS:

- A. Materials to be mold, humidity, and erosion resistant surface to meet the requirements of UL 181.

2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Insulating Manufacturers: Johns Manville, Knauf, Armstrong, Owens-Corning, Pabco, IMCOA, Certain Teed or accepted substitute.
- B. Adhesive Manufacturers: Benjamin Foster, 3M, Borden, Kingco or Armstrong.

2.02 PIPING INSULATION, JACKETING AND ACCESSORIES:

- A. Fiberglass Pipe Insulation:
  - 1. Fiberglass™ Evolution™ Paper-free ASJ Pipe Insulation.
  - 2. Pipe system to minus 10 to 55 deg. F: Flexible, preformed, pre-slit, self-sealing elastomeric, thermal conductivity of 0.27 Btu/hr. sq. ft./in. at 75 deg. F and vapor transmission rating of 0.2 perms/inch. Apply in thickness necessary to prevent condensation on the surface.
  - 3. Piping Systems 55 to 600 deg. F: Glass fiber preformed pipe insulation with a minimum K-value of 0.23 at 75 deg. F, a minimum density of 3.5 pounds per cubic foot.
  - 4. Pipe System Up to 1200 deg. F: High temperature molded calcium silicate insulation with factory applied aluminum metal jacket. Furnish with aluminum snap straps.
- B. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric. Thermal Conductivity value: 0.27 at 75°F. Maximum Flame Spread: 25. Maximum Smoke Developed: 50 (3/4-inch thick and below). Connection: Waterproof vapor retarder adhesive as needed. UV Protection: UV outdoor protective coating as needed.
- C. Plastic Pipe Insulation: Flexible unicellular polyolefin foam insulation complying to ASTM C534, ASTM E84 (25/50), UL 723 (25/50). Thermal conductivity of 0.24 (BTU/in)/ (hr./sq. Ft./deg. F) at 75°F. Preslit longitudinal seam. Imoca.
- D. Fiberglass Insulation: Flexible Fiber Glass Blanket: ASTM C612; flexible. Thermal Conductivity Value: 0.24 at 75°F. Maximum Service Temperature: 450°F.
- E. Jackets:
  - 1. Interior Applications:

- a. PVC Jackets: One-piece, pre-molded type color and labeling to match existing and comply with Beaverton School District standards.

F. Accessories:

1. Insulation Bands: 3/4-inch-wide; 16-gauge stainless steel.
2. Metal Jacket Bands: 0.25 thick stainless steel.
3. Insulating Cement: ANSI/ASTM C195; hydraulic setting mineral wool.
4. Finishing Cement: ASTM C449.
5. Fibrous Glass Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.

2.03 DUCT INSULATION AND JACKETS:

- A. Duct Wrap: 1 1/2-inch flexible glass fiber; ANSI/ASTM C612; commercial grade; 'k' value of 0.27 at 75 degrees F. 1.0 pcf.
- B. Duct liner: ASTM 1071; flexible blanket. 'K' Value: ASTM C518, 0.25 at 75°F. Noise Reduction Coefficient: 0.65 or higher based on "Type A mounting." Maximum Velocity on Mat or Coated Air Side: 5,000 FPM. Adhesive: UL listed waterproof type. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened. Mold, humidity, and erosion resistant surfaces: UL 181.
- C. Jacketing and Fasteners:
  1. Indoor Jacket: Foil-Skrim-Kraft.
  2. Outdoor Jacket: Coated glass fiber sheet, 30 lb/sq yd.
  3. Lagging Adhesive: Fire resistive to ASTM E84, NFPA 255, and UL 723.
  4. Impale Anchors: Galvanized steel, 12-gauge, self-adhesive pad.
  5. Joint Tape: Glass fiber cloth, open mesh.
  6. Tie Wire: Annealed steel, 16 gauge (1.5 mm).
- D. SoftR® Duct Wrap Paper-free ASJ and VaporWick® or equal approved.

2.04 PIPE FITTING INSULATION COVERS:

- A. PVC preformed molded insulation covers. Zeston or accepted substitute.

2.05 DUCT INSULATION ACCESSORIES:

- A. Staples, bands, wires, tape, anchors, and accessories as recommended by insulation manufacturer.

2.06 DUCT INSULATION COMPOUNDS:

- A. Cements, adhesives, coatings, sealers, finishes and accessories as recommended by insulation manufacturer.

2.07 OUTDOOR DUCTING:

- A. Aluminum Jacket: 0.016-inch thick sheet, smooth/embossed finish, with longitudinal slip joints and 2-inch laps.
- B. Non-water vapor retarder, nonburning weatherproof coating for use over insulation where "breathing" is required.
- C. UV resistant polyvinyl chloride covering with joints secured and sealed.

3 EXECUTION

3.01 PREPARATION:

- A. Install materials after piping, ductwork and equipment has been tested and approved.

3.02 PIPING INSULATION INSTALLATION:

- A. Install materials in accordance with manufacturer's instructions.
- B. Continue insulation with vapor barrier through penetrations.
- C. In exposed piping, locate insulation and cover seams in least visible locations.
- D. Provide an insert, not less than 6 inches long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2 inches diameter or larger, to prevent insulation from sagging at support points. Inserts shall be cork or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.
- E. Neatly finish insulation at supports, protrusions, and interruptions.
- F. Jackets:
  - 1. Indoor Applications: Insulated pipes conveying fluids above ambient temperature shall have standard jackets, with vapor barrier, factory-applied or field applied. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass cloth and adhesive. Color and labeling to match existing and Beaverton School District standards.
  - 2. Buried Piping: Insulate with Plastic Pipe Insulation. Same thickness as specified for pipe size and applications listed in schedule below.
- G. Piping Insulation Schedule:

<u>PIPING</u>	<u>PIPE SIZE</u>	<u>INSULATION</u>
Heating Water Supply		

and Return	2" and Smaller	1-1/2" fiberglass
	2-1/2" to 4"	1-1/2" fiberglass
	4" and Larger	1-1/2" fiberglass
Refrigerant Suction/Hot Gas	All Sizes	1" elastomeric foam
Piping Exposed to Freezing	All Sizes	1-1/2" fiberglass

H. Pipe Fittings:

1. Insulate and finish all fittings including valve bodies, bonnets, unions, flanges and expansion joints with precut fiberglass insulation and preformed PVC covers sealed to adjacent insulation jacket for continuous vapor barrier covering over all fittings.

I. Piping Insulation Lap Seams and Butt Joints: Install insulation jacket in accordance with manufacturer's recommendation. Where jacket joint and lap seams have not adhered, remove affected section of insulation and reinstall.

J. Where piping is installed in the exterior building envelope or in any component of the exterior building envelope it shall be located on the warm building interior side of the building envelope insulation.

3.03 DUCTWORK INSULATION INSTALLATION:

A. Install materials in accordance with manufacturer's instructions.

B. Installation:

1. Butt insulation joints firmly together and install jackets and tapes securely.
2. Apply duct insulation continuously through sleeves and openings. Apply vapor barrier materials to form a vapor seal over the insulation.
3. Cover breaks in the jacket material with patches of the same material as the vapor barrier. Extend the patches 2-inches beyond the break in all directions and secure with adhesive.
4. Seal insulation terminations and pin punctures with a reinforced vapor barrier coating.
5. Continue insulation at fire dampers up to and including those portions of the fire damper frame which are visible at the outside of the rated barrier.
6. Do not conceal duct access doors with insulation.
7. Duct Liners: Install mat finish surface on air stream side. Secure insulation on sheet metal duct with a continuous 100 percent coat of adhesive. For widths over 20-inch, additionally secure the liner with mechanical fasteners 15-inch on center. Cut liner and coat ends with adhesive. Butt joint tightly. Top and bottom sections of insulation overlap sides. Keep duct liner clean and free from dust. If insulation is installed without horizontal, longitudinal and end joints butted together, installation will be rejected.

8. Duct Wrap: Cover supply air ducts except ducts internally lined or where fiberglass ductboard is utilized. Wrap tightly with all circumferential joints butted and longitudinal joints overlapped minimum of 2-inch. Adhere insulation with 4-inch strips of insulating bonding adhesive at 8-inch on center. On ducts over 24-inch wide, additionally secure insulation with suitable mechanical fasteners at 18-inch on center. Circumferential and longitudinal joints stapled with flare staples 6-inch on center and covered with 3-inch wide foil reinforced tape.

C. Continue insulation with vapor barrier through penetrations.

D. Internally Lined Ductwork: Where internally lined ductwork is indicated, no exterior insulation is required. Lap the ends of the exterior insulation a minimum of 6 inches past the interior insulation unless otherwise shown. Seal the end of vapor barrier jacket to the duct with mastic where the vapor barrier is required.

3.04 DUCTWORK SURFACES TO BE INSULATED:

<u>Ductwork</u>	<u>Duct Size</u>	<u>Insulation Thickness</u>
Supply and return ductwork (except where duct is lined)	all	1-1/2" Duct wrap
Supply and return ductwork (exposed to weather and in unheated areas)	all	2" Duct wrap
Outside air ducts	all	2" Duct liner
HVAC plenums	all	2" Duct liner

3.05 PLASTIC PIPE INSULATION:

- A. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover all insulation exposed to the weather and under grade with 2 coats of finish as recommended by manufacturer.

3.06 FLEXIBLE ELASTOMERIC TUBING:

- A. Slip insulation over piping or if piping is already installed, it should be slit and snapped over the piping. All joints and butt ends must be adhered with adhesive.

3.07 INSULATION SHIELDS:

- A. Provide full size diameter hangers and shields (18-gauge minimum) for all cold piping. Hot water piping hangers may penetrate insulation to contact piping directly.

END OF SECTION

1 GENERAL

1.01 COMMISSIONING:

- A. The project will have selected building systems commissioned. The equipment and systems to be commissioned and the commissioning process is described in Section 01 91 13 - "General Commissioning Requirements".

1.02 RELATED SECTIONS:

- A. Section 01 91 13 - General Commissioning Requirements.

1 GENERAL

1.01 WORK INCLUDED:

- A. Furnish a complete and fully operating Microsoft Windows based Johnson Controls Direct Digital Control system (DDCS) in accordance with Beaverton School District standards and this specification section. All components of system shall conform to most recent open protocol requirements of BACnet by ASHRAE. Any component or part of system that does not comply with BACnet shall have an intermediate communication device or gateway supplied under this scope of work that makes that component, subsystem, or system compliant with BACnet, for open protocol purpose, with higher level control components or systems that may be added in future. Items of work included are as follows.
1. Provide all necessary hardware and software to meet the specified functional requirements.
  2. Prepare individual hardware layouts, interconnection drawings and control loop configuration data from project design data.
  3. Implement the detailed design for all system input/output points, distributed control and system data bases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
  4. Design all equipment cabinets, panels, and the data communication network cables including all associated hardware.
  5. Provide and install all cabinets, panels, and data communication network cables including all associated hardware.
  6. Provide and install all interconnecting cables between supplied cabinets, controllers, and output devices.
  7. Provide and install all interconnecting cables between all operator terminals and peripheral devices (such as printers, etc.) supplied under this section.
  8. Provide complete specifications for all items supplied by the Vendor from others (such as printers, instruments, etc.).
  9. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, start-up and commissioning.
  10. Provide a comprehensive operator and technician training program as described herein.
  11. Provide as-built documentation, software, and all DDC control logic and all associated support documentation on approved media which accurately represents the final system.
  12. Provide an electronic copy of all programming.
  13. Provide all license agreements, with MRIPA being the owner of the license, from DDC software and hardware to owner.

14. Provide twenty-four (24) hours of owner training. Training to be provided at owner's direction but in not less than four (4) hour blocks of time.
15. Wireless controls will be considered by BSD on a case by case basis for this project.

1.02 RELATED WORK:

A. Related work in other sections of the specifications:

1. Section 23 0500, Basic Materials and Methods
2. Divisions 26 and 28, Basic Electrical Requirements

1.03 SYSTEM DESCRIPTION:

A. General Requirements:

1. Provide a Distributed Processing System complete with Direct Digital Control (DDC) software. This system is to control all VAV boxes, RTU's, fans, coils, dampers, and other specified equipment directly, without intervening conventional controls.
2. All DDC Controllers for terminal units, air handlers, Central mechanical equipment, and Windows based operators' terminal(s) shall communicate with each other and share information.
3. The controls contractor shall assume complete responsibility for the entire controls system as a single source and shall certify that he has on staff under his direct employ on a day to day basis, factory trained technical personnel, qualified to engineer, program, debug, and service all portions of the DDC control system, including central system Operators terminal, global controllers, terminal unit controllers, and all other portions of the DDC control system.
4. System to be completely based on ANSI/ASHRAE STANDARD 135-2001, BACnet.

B. Basic System Features:

1. Zone by zone DDC control of space temperature, usage scheduling, optimum starting, equipment failure reporting, and override timers for off-hours usage. A zone is the area served by one HVAC terminal unit (VAV box, heat pump, unit ventilator, fan coil, etc.)



2. Operator's workstation software shall be latest version of Microsoft Windows as the computer operating system. The energy Management and Control System (EMCS) application program shall be written to communicate specifically utilizing BACnet protocols. Software functions delivered on this project shall include password protection, scheduling, (including optimum start) alarming, logging of historical data, full graphics including animation, demand limiting, full suite of field engineering tools including graphical programming and applications. Systems using operating systems other than that described above are strictly prohibited. All software required to program application specific controllers and all field level devices and controllers will be left with the owner. All software passwords required to program and make future changes to the system will also become the property of the owner.

All software required to make any program changes anywhere in the system along with scheduling, and trending applications will be left with the owner. All software passwords required to program and make future changes to schedules, trends and related program changes will also become the property of the owner. All software required for all field engineering tools including graphical programming and applications will be left with the owner. All software passwords required to program and make future changes to field engineering tools including graphical programming and applications will be left with the owner.

3. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
4. System to have the ability to interface with and record electrical meter data and interact with metering software from other vendors. System to be compatible with and interface with Dashboard systems
5. All application controllers for every terminal unit (VAV, HP, UV, etc.) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller via BACnet LAN. Programming shall be specific for this project.
6. The complete system including but not limited to terminal unit controllers, Global controllers and Operator terminals shall Auto-restart, without operator intervention, on resumption of power after a power failure. Database stored in Global Controller memory shall be battery backed up for a minimum of 30 days. Unitary controllers shall utilize EEPROM for all variable data storage. Battery backed up Unitary controllers shall not be allowed
7. Priority password security systems to prevent unauthorized use. Each user shall have an individual password. Each user shall be assigned which control functions they have access to.

8. Equipment monitoring and alarm function including information for diagnosing equipment problems.
9. The complete system including but not limited to terminal unit controllers, Global controllers and Operator terminals shall Auto-restart, without operator intervention, on resumption of power after a power failure. Database stored in Global Controller memory shall be battery backed up for a minimum of 30 days. Unitary controllers shall utilize EEPROM for all variable data storage. Battery backed up Unitary controllers shall not be allowed.
10. Modular system design of proven reliability.
11. Each field panel capable of independent control.
12. All software and/or firmware interface equipment for connection to remote monitoring station from field hardware or the Operators Terminal.
13. Equipment runtime totalization of fans, heaters, boilers, etc., capable of alarm generation and alarm dial out to remote sites.
14. Room sensors with unoccupied schedule override
15. Field control devices such as terminal unit controllers shall have optically isolated communication lines. Controllers not optically isolated and utilizing a ground referenced communication technique are specifically prohibited.
16. Communication wiring for field control devices shall not be dependent on daisy chaining of communication wiring. Communication wire to be run in daisy chained fashion, allowing units to be added to a communication line easily in the future.
17. All DDC hardware and software shall be designed and manufactured by U.S. corporations. All hardware shall be U.L. listed with integral labels showing rating.

1.04 QUALITY ASSURANCE:

- A. Responsibility: The supplier of the DDCS shall be responsible for inspection and Quality Assurance (QA) for all materials and workmanship furnished by him.
- B. Component Testing: Maximum reliability shall be achieved through extensive use of high-quality, pre-tested components. Each and every controller, sensor, and all other DDC components shall be individually tested by the manufacturer prior to shipment.
- C. Tools, Testing and Calibration Equipment: Provide all tools, testing and calibration equipment necessary to ensure reliability and accuracy of the DDCS.

1.05 REFERENCE STANDARDS:

- A. The latest edition of the following standards and codes in effect and amended as of date of Supplier's Proposal, and any subsections thereof as applicable, shall govern design and selection of equipment and material supplied:

1. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers
  2. UBC: Uniform Building Code, including local amendments
  3. UL 916 Underwriters Laboratories Standard for Energy Management Equipment
  4. NEC: National Electrical Code
- B. City, county, state, and federal regulations and codes in effect as of date of purchase.
- C. Except as otherwise indicated, vendor shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

1.06 SUBMITTALS:

- A. Drawings:
1. Within four weeks after award of contract, the Supplier shall submit review drawings, installation and operation instruction and a recommended spare parts list.
  2. Drawings shall be standard sizes (24 inches x 36 inches) or (11 inches x 17 inches).
  3. Provide three copies of submittal drawings.
- B. System documentation by the Vendor shall include the following as a minimum:
1. System configuration diagrams in simplified block format.
  2. Input/output point and alarm point summary listing.
  3. Electrical drawings showing all system internal and external connection points, terminal block layouts and terminal identification.
  4. Complete written description of system sequence of operation.
  5. Manufacturer's instructions and drawings for installation, maintenance and operation of all purchased items.
  6. Overall system operation and maintenance instructions, including preventive maintenance and troubleshooting instructions.
  7. Complete recommended spare parts list.

1.07 SCHEDULING AND COORDINATION:

- A. The Vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases.

- B. The schedule shall show all the target dates for transmission of project information and documents and will indicate system installation, debug, and commissioning timing dates.

1.08 WARRANTY:

- A. Warranty shall cover all costs for parts, labor, and associated travel, and expenses for a period of three (3) years from completion of system demonstration and training.
- B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the Vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours.
- C. This warranty shall apply equally to both hardware and software.

2 PRODUCTS

2.01 SYSTEM MANUFACTURER:

- A. DDC temperature control system shall be a Johnson Control system furnished by Johnson Control Inc, Northwest Control Contractors, or Automated Controls, no substitutions. Network Automation Engine shall be Johnson Controls NAE55 series or as approved by owner.

2.02 SYSTEM TERMINAL:

- A. Displays:
  - 1. All operator interface will be web based requiring no special programming to access. All server level software must be approved by BSD IT department.
  - 2. Operator interface shall display all data associated with project as called out on drawings and/or point list supplied. Terminal software shall accept either PCX or Windows BITMAP format graphic files for display purposes. Graphic files shall be created utilizing scanned full color photographs of system installation, Autocad drawing files of field installation drawings and wiring diagrams from as-built drawings. System shall be capable of displaying graphic file, text and dynamic point data together on each display. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. Terminal shall allow user to change all field resident EMS functions associated with the project such as set points, time schedules, holiday schedules, etc. This shall be done without any reference to point addresses or other numeric/mnemonic indications.
  - 3. All displays shall be generated and customized in such a manner by the local DDCS supplier that they fit the project as specified. Displays shall use standard English (or specified language) for labeling and readout. Systems requiring factory programming for graphics or DDC logic are specifically prohibited. All graphics and DDC programming shall be supported locally by the installing contractor without factory dependency or assistance.

4. Digital points shall be displayed as on/Off or with customized text. Text shall be justified Left, Right or Center. Also allow digital points to be displayed as individual bitmap objects on the display screen as an overlay to the system graphic. Each digital point displayed in this manner shall be assigned up to three bitmap files for display when the point is On, Off or in Alarm. For Digital Output points, toggle the points commanded status when the bitmap is selected with the system digitizer (mouse) by the operator (i.e. selecting a picture of a switch or light with the mouse shall toggle the points status and display a different picture). Also allow digital points to be displayed as an animated graphic. Animated graphic points shall be displayed as a sequence of multiple bitmaps to simulate motion (i.e. when a pump is in the OFF condition, display a stationary picture of the pump. When the operator selects the picture with the mouse, the points status is toggled, and the picture of the pump rotates the vanes in a time-based animation). Allow operator to change bitmap file assignment and also create new and original bitmaps on line. System shall be supplied with a library of standard bitmaps which may be used unaltered or be modified by the operator. Systems that do not allow customization or creation of new bitmap objects by the operator shall not be allowed.
5. Analog points shall be displayed with operator modifiable units. Analog Input points may also be displayed as individual bitmap objects on the display screen as an overlay to the system graphic. Each analog input point may be assigned to a minimum of five bitmap files each with High/Low limits for automatic selection and display of the bitmaps. As an example, a graphic representation of a thermometer would rise and fall in response to either the room temperature or its deviation from the controlling setpoint. Analog Output points, when selected with the mouse, shall be displayed as a prompted dialog box, adjustable knob or slide bar. Selection for display type shall be individual for each point.
6. Analog points may also be assigned to an area of a system graphic, where the color of the defined area would change based on the analog points value. As an example, an area of a floor plan graphic served by a single control zone would change color respective to the temperature of the zone or its deviation from setpoint. Selection of the graphic area to be done using a "Roller Brush Flood Fill" tool similar to ones used in painting programs. All editing and area assignment shall be created or modified on-line, using simple icon tools.
7. A Customized Menu Label shall be used for display selection. Menu items on a display shall allow penetration to lower level displays or additional menus. Dynamic point information and menu items may be mixed on the same display to allow sub displays to exist for each item. Each display may be protected from viewing unless operator has appropriate security level. A separate display security level may be assigned to each display and system point.
8. All dynamic point information shall be updated on the Operators terminal display CRT once every 1 second. Any changes by the operator shall be acted on by devices in the field within 2 seconds maximum.
9. A Mouse or other form of digitizer shall be used to move pointer arrow to desired item for selection of new display or to allow the operator to make changes to point data.

10. Displays may be modified on site or via remote communications.
11. Display resolution shall be limited by the physical monitor properties and software driver. A minimum resolution of 1024x768 @16bit (65,536 colors). Entire system shall operate without dependency on the Operator's terminal.
12. Entire system shall operate without dependency on the Operator's terminal.

2.03 SECURITY SYSTEM:

- A. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator terminal's functions unless user is logged on. This includes displays as outlined above.
- B. Each Operators Terminal shall provide security for 100 users minimum. Each user shall have an individual password. Password and User name shall each be up to 30 alpha numeric characters, case sensitive. Each User shall be individually assigned which control functions and menu items the user has access to. All passwords, user names and access assignments shall be adjustable on-line, at the operator's terminal.
- C. System shall maintain a log of all user activities while logged onto the system. Provide for easy viewing of all items in user log, including time and date of login, logoff and all activities in between

2.04 DISPLAY OF SCHEDULING INFORMATION:

- A. Display of Weekly schedules shall show all information in easy to read 7-day (week) format for each schedule. This includes all on/off times for each day along with all optimum start information.
- B. Holiday schedules shall show all dates that are to be holidays. Holidays shall be shown on the terminal in a graphical calendar format showing all scheduled days for a given month. User shall be able to easily scroll through the months for each year for up to 20 years into the future as a minimum. Each day assigned as a holiday shall display as "All Off" or show the times scheduled for that day
- C. Event schedules shall be shown in the same graphical calendar format and manner as Holiday schedules. Event schedules allow for scheduling of special events up to 20 years into the future. After event has elapsed, control returns to normal schedule.
- D. Operator shall be able to change all information for a given Weekly, Holiday or Event schedule if logged on with the appropriate security access. This includes all information that has to do with optimum start assignments such as sensors to use and heating/cooling factors

2.05 ALARM INDICATION:

- A. System Terminal shall provide audible, visual and printed means of alarm indication. The Alarm Dialog box shall always become the Top Dialog box regardless of the application(s) being run at the time (such as a word processor). Printout of alarms shall be sent to the assigned terminal and port.
- B. Provide log of alarm messages. Alarm log shall be archived to the hard disk of the system terminal. Each entry shall include point descriptor and address, time and date of alarm occurrence, point value at time of alarm, time and date of point return to normal condition, time and date of alarm acknowledge.
- C. Alarm messages shall be in plain English (or specified language) and shall be user definable on site or via remote communication. System shall provide a minimum of 20 user definable messages for each zone controlled.

2.06 TREND LOG INFORMATION:

- A. System shall periodically gather samples of point data stored in the field equipment (see section 2.2.D) and archive the information on the Operator terminals hard disk. Archive files shall be appended with new sample data, allowing samples to be accumulated over several years. Systems that write over archived data shall not be allowed. Samples may be viewed at the operator's terminal in a Trend Log. Trend log displays shall be in spreadsheet format. Provide a minimum of 100 Trend Log displays at each terminal. Each trend log display shall be capable of a minimum of 100 trended points, with a minimum of 10,000 samples for each trended point. Provide capability for operator to scroll through all trend log data vertically (time axis) and horizontally (point sample columns). System shall automatically open archive files as needed to display archived data when operator scrolls through the data vertically. Display all trend log information in standard engineering units.
- B. System software shall be capable of graphing the trend log point data. Software shall be capable of creating graphs in the following forms as a minimum:
  - 1. Bar charts, Log/Linear graphs, Bubble graphs,
  - 2. x-y graphs, Log/Log graphs, Area graphs (2D or 3D),
  - 3. Pie charts, Scatter graphs, Polar graphs,
  - 4. High-Low-Close graphs
- C. Operator shall be able to change trend log setup information as well. This includes information to be trend logged as well as interval at which information is to be logged. All points in the system may be logged. All operations shall be password protected.

2.07 ENERGY LOG INFORMATION:

- A. System shall periodically gather energy log data stored in the field equipment (see section 2.2.H) and archive the information on the Operator terminals hard disk. Archive files shall be appended with the new data, allowing data to be accumulated over several years. Systems that write over archived data shall not be allowed. Log data may be viewed at the operator's terminal in a spreadsheet format. Provide a minimum of 100 Energy Log displays at each terminal. Provide capability for operator to scroll through all Energy log data vertically (time axis) and horizontally (point sample columns). System shall automatically open archive files as needed to display archived data when operator scrolls through the data vertically. Display all Energy log information in standard engineering units.
- B. System software shall be capable of graphing the Energy log data. Software shall be capable of creating graphs in the following forms as a minimum:
  - 1. Bar charts, Log/Linear graphs, Bubble graphs,
  - 2. x-y graphs, Log/Log graphs, Area graphs (2D or 3D),
  - 3. Pie charts, Scatter graphs, Polar graphs,
  - 4. High-Low-Close graphs
- C. Operator shall be able to change the Energy log setup information as well. This includes which meters to be logged and meter pulse value. All meters monitored in the system may be logged. All operations shall be password protected.

2.08 CONTROLLER STATUS:

- A. Provide means for operator to view communication status of all controllers connected to the system. Display shall include controller, status and error count. Status will show if controller is communicating or not. Error count shall show actual count of communication errors between system and controllers in the field.
- B. Provide means for operator to reset error count for all controllers to zero.
- C. Provide capability to select alarm indication for each controller.

2.09 CONFIGURATION/SETUP:

- A. Provide means for operator to display and change system configuration. This shall include but not be limited to system time, day of the week, date of day light savings set forward setback, printer type and port addresses, modem port and speed, etc. Items shall be modified utilizing easy to understand terminology using simple mouse/cursor key movements.



2.10 CUSTOM REPORT GENERATOR:

- A. Custom report generator shall allow the operator to create multiple custom reports utilizing system point information, text and outputs of other software modules such as trend logging, controller status, point values, etc. Operation shall be similar to a word processing program allowing easy manipulation of report text, content, font and initiation parameters. Reports may be manually or automatically printed to system printer. Automatic printing initiation may be by assignment to a schedule (Weekly, Holiday or Event schedules), point Change of State (COS), point alarm condition, or point value.
- B. Reports shall fully support Windows DDE and OLE allowing information from other software programs (such as spreadsheet programs) to be part of the report.

2.11 OCCUPANT OVERRIDE LOGGING AND BILLING:

- A. Night cycle override of zone temperature control, lighting, etc., shall be automatically logged by field devices (Global Controllers) on a zone by zone basis. See section 2.2.G for description. Operator Terminal software shall allow zones to be grouped for totalization of all zones within the area over an adjustable time period. System shall include a billing program for creation of charges based on the billing rate and the totaled override usage from specified begin and end dates.

2.12 CAMPUS LOCAL AREA NETWORK:

- A. In addition to the LAN communication between the Operator Terminals and the Global Controllers (hereafter called a LOCAL system), the local system shall also be capable of connecting to other local systems or Operators terminals via a Campus LAN. The Campus LAN shall be any of the ETHERNET type LANs available. Provide all ETHERNET hardware and Windows Network software necessary for a complete and operational system.
- B. Any point in the interconnected system, comprised of all local systems connected together with the Campus LAN, shall be available for any and all functions of any one of the local systems. As an example, an electric meter input to one of the local systems shall be capable of being utilized in any of the other local systems demand limiting program(s).

2.13 GLOBAL CONTROLLER:

- A. General:
  - 1. Global controller shall provide battery backed real time clock functions. It shall also provide system communications to programmable and application specific controllers as noted in section 2.3 in the field. Global controller shall interface with Operator terminal(s) for information display. Global controllers shall share information in a Peer-to-Peer manner utilizing a high-speed LAN communication network. Global Controller shall be capable of 1 Meg baud LAN communication rates.

2. Global controller shall decide global strategies for system based on information from any points in the system regardless if the point is directly monitored by the controller. Program that implements these strategies shall be completely flexible and user definable. Any system utilizing factory pre-programmed global strategies that cannot be modified by field personnel on site or downloaded via remote communications are not acceptable. Changing global strategies via firmware changes is also unacceptable. Program executed speed shall be once per second as a minimum.
3. Programming shall be object oriented using control program blocks. Provide documentation in flow chart form for all programming as part of the final system As-Built documentation. Include samples of flow chart documentation in submittals. All flow charts shall be generated with CAD system and automatically downloaded to controller. No reentry of data base shall be necessary.
4. Provide means to view inputs and outputs to each program block in real time as program is executing. This function may be done via the Operators Terminal, field computer, or via modem.
5. Controller shall have a minimum of 128mb RAM (SDRAM). Provide JACE-3 if project requires 10-15 controllers; JACE-6 if project requires up to 50 controllers; and JACE-7, with 1Gb DDR-2 RAM if project has 50 or more controllers.
6. Communication to field devices shall be via four individual two wire communication trunks. Communication baud rate shall be at 76,800 BAUD. All field devices shall automatically search and detect the communication rate to match the Global controller. All field devices on the communication trunk shall be optically isolated. Ground referenced communications to field devices is prohibited. Routing of communication trunk to be daisy chained.
7. Controller shall have at a minimum, four (4) additional communication ports in addition to the LAN port. Two of the ports shall be RS-232, one for communication to portable field computer and one for a modem for remote communications. The other two ports shall be RS-485 for connection to a permanent panel mounted display device (see 2.2.1 for description), and for future connection to other devices.

B. Remote Communications:

1. Provide all functions that will allow remote communications via modem to off-site locations. Include modem along with all cabling necessary for installation.
2. Provide Windows 7 Ultimate compatible software for off-site computer which allows operator to view and change all information associated with system on color graphic displays if desired. Operator shall be able to change all parameters in this section from off-site location including all programming of global controllers and programmable terminal unit controllers.

3. Global Controller shall have capability to call out alarm conditions automatically if desired. Alarm message and site description may be sent to offsite computer or serial printer. If desired, controller may also send encoded message to digital pager. All Global controllers connected to the local LAN shall be capable of calling out alarm messages through one shared modem connected to one of the Global controllers on the local LAN.
4. Controller shall have capability to call 10 different phone numbers each as a minimum. Numbers called may be controlled by time schedule or other selectable program parameters.
5. Owner shall provide standard voice grade phone line for remote communication function.
6. Global controller and supplied modem shall be capable of modem-to-modem baud rates of 9600 baud minimum over standard voice grade phone lines. Lower baud rates shall be selectable for areas where local phone company conditions require lower baud rates.

2.14 SCHEDULES:

- A. Schedules shall be arranged in a three-tiered hierarchy as follows:
  1. Highest level: Event Schedules
  2. Middle level: Holiday Schedules
  3. Lowest level: Weekly Schedules
- B. Each Global Controller shall have at a minimum:
  1. 100 Weekly time schedules (7 day)
  2. 100 Holiday schedules (400 programmable days each)
  3. 20 Event schedules (400 programmable days each) With 8 schedule entries per day.
- C. Each schedule may be assigned to any point, controller, or program in the system.
- D. Each schedule (Weekly, Holiday and Event) shall be capable of performing an optimum start. Optimum start calculation shall be based on outside air temperature, zone air temperature deviation from zones daytime heating and cooling setpoints, and individual zone adaptive heating and cooling coefficients that are adjusted each day based on performance parameters of the individual zone. Each schedule may use identical or individual sensors in its calculations.
- E. Holiday schedule shall be provided to allow operation of system based on different schedule on specified holidays. Display of Holiday schedule shall be via a monthly calendar format. Operator shall be able to scroll through months and years. Operator shall be capable of scheduling dates a minimum of 20 years into the future.
- F. Event schedules shall be identical to Holiday schedule format and requirements.

- G. Operator may define and setup all schedule information from system terminal, via portable computer on site or via remote communications. This includes all times, dates and optimum start parameters. These functions shall be password protected.

2.15 Logging Capabilities:

- A. Each Global Controller shall log as a minimum 256 user selectable points with a minimum of 1440 samples per point. Sample time interval shall be from 1 to 1000 seconds. Sample initiation may be by any of the following conditions:
  - 1. Selectable begin and end date and time
  - 2. Point COS (Any system point)
  - 3. Point Alarm Status (Any system point)
  - 4. Schedule ON status (Weekly, Holiday or Event schedules)
  - 5. Any point in the system whether it is real or calculated may be logged.
  - 6. Logs may be viewed both onsite and off-site via remote communication.
  - 7. Global controller shall periodically upload trended data to Operator terminal for long term archiving if desired.
  - 8. Trend Logs Definition
    - a. The operator interface shall allow a user with the appropriate security permissions to define a trend log for any data in the system.
    - b. The operator interface shall allow a user to define any trend log options as described in the Application and Control Software section.
  - 9. Trend Log Viewer
    - a. The operator interface shall allow Trend Log data to be viewed and printed.
    - b. The operator interface shall allow a user to view trend log data in text-based (time –stamp/value).
    - c. The operator shall be able to view the data collected by a trend log in a graphical chart in the operator interface.
    - d. Trend log viewing capabilities shall include the ability to show a minimum of 5 points on a chart.
    - e. Each data point trend line shall be displayed as a unique color.
    - f. The operator shall be able to specify the duration of historical data to view by scrolling and zooming.

- g. The system shall provide a graphical trace display of the associated time stamp and value for any selected point along the x-axis.

10. Export Trend Logs.

- a. The operator interface shall allow a user to export trend log data in CSV or PDF format for use by other industry standard word processing and spreadsheet packages.

2.16 ALARM GENERATION:

- A. Alarms may be generated for any condition of the system. This includes things such as analog point high/low alarm limits, digital point COS, communication failure to terminal unit controllers, etc. Controller shall have a minimum of 6 alarm types with 7 categories for each type.
- B. Each alarm may be dialed out as noted in paragraph B. above.
- C. Provide alarm log for viewing of alarms. Log may be viewed on site at the system terminal or off-site via remote communications.

2.17 DEMAND LIMITING:

- A. System shall monitor energy demand. Energy demand may be from any type of energy source such as electrical or gas. Provide a Demand Limiting routine which shall shed assigned points or zones in the system to prevent the demand from exceeding preset limits. Demand limiting routine shall be a priority shed type allowing automatic override of zone or point shed when assigned temperature sensor exceeds operator set limits. Routine shall be able to change between 4 sets of demand limit and restore setpoints based on time of day or operator command.
- B. Zone shed method shall be by either preventing operation of heating and cooling, or by shifting the zones heating and cooling setpoints.
- C. All parameters of the Demand Limiting routine shall be modifiable from the Operators Terminal or via remote communications.

2.18 OCCUPANT OVERRIDE LOGGING AND BILLING:

- A. Night cycle override of zone temperature control, lighting, etc., shall be automatically logged on a zone by zone basis. Zones may be grouped into areas for totalization of all zones within the area over an adjustable time period. System shall include a billing program for creation of charges based on the billing rate and the totaled override usage from specified begin and end dates.
- B. Provide Global Controller capacity to total override usage for a minimum of 100 areas with up to 256 zones per area and 30 overrides per zone. Global controller shall periodically upload the override information to the System terminal for long term archiving and billing generation.

2.19 ENERGY LOGGING:

- A. Each global controller shall have ability to provide for a minimum of 10 Energy Logs. When required by specified sequence of operation, each log shall monitor an energy meter and record or calculate the following information for each Day, Month and Year:
  - 1. Energy consumption
  - 2. Demand peak value and time of peak
  - 3. Outside air temperature minimum, maximum and average value
  - 4. Heating and Cooling degree day calculation
- B. Energy meter input may be from any type of energy source such as electric or gas. Input type shall be dry contact pulse.

2.20 TERMINAL UNIT CONTROLLERS:

- A. General:
  - 1. Provide programmable and application specific Terminal Unit Controller as needed to comply with sequence of operation, point list and drawings. All Terminal Unit Controller units shall be completely stand-alone with no loss of control if communication with global controller is interrupted. All control parameters, DDC programs and local variables such as setpoint information shall be stored in EEPROM on board each Terminal Unit Controller allowing the operator to change information as desired. Controllers that utilize a battery to backup control parameters, etc. Shall not be allowed.
  - 2. All points on drawings, in sequence of operation and on point list shall be connected to and controlled by DDC units. No control shall be done by external devices such as thermostats or analog controls that are not part of the DDC system.
  - 3. Programmable Terminal Unit Controllers shall be used in custom applications such as central plant, built up air handlers, fume hoods or when application specific controllers' sequence of operation is not applicable.
  - 4. Communication from Global controller to Terminal Unit Controllers shall be via two wire communication trunks as specified for Global Controllers above. Any type of Terminal Unit Controller shall communicate on the same communication trunk. System shall communicate to one Terminal Unit Controller regardless of whether other Terminal Unit Controllers on the same communication line are powered and connected. Ground referenced communications is prohibited.
- B. Programmable Terminal Unit Controllers:
  - 1. Each programmable Terminal Unit Controller shall be completely programmable from the system terminal, via field computer or via remote communications. Program execution rate shall be ten times per second minimum (once every 100 milliseconds).

2. This controller shall be programmed to perform custom strategies for system based on information from all points in the field. Program that implements these strategies shall be completely flexible and user definable. Any controllers utilizing factory programmed strategies that cannot be modified by field personnel on site, require factory assistance, or cannot be downloaded via remote communications are not acceptable. Changing strategies via firmware changes is also unacceptable.
3. Programming shall be object oriented using program blocks familiar to control specialists for all program strategies. Provide documentation in flow chart form for all programming. Include samples of flow chart documentation in submittals. All flow charts shall be generated with CAD system and automatically downloaded to controller. No re-entry of data base shall be necessary. As-Built documentation of all software shall be provided to end user in flow chart form at completion of project.
4. Program and program parameters such as set points shall be stored in EEPROM. Battery backed RAM shall not be accepted for this level of controller.
5. All inputs shall be universal in that they accept analog and digital information. Inputs shall be capable of detecting a 0.1 second momentary closure. Analog inputs shall be capable of accepting thermistor inputs, 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA inputs. No external hardware shall need to be added for Terminal Unit Controller to accept these different types of inputs. All inputs shall utilize a minimum of 10 bit analog to digital conversion.
6. Each of the analog outputs shall be independently switch selectable to output 0 to 10 VDC or 4 to 20 mA. Unit shall be programmable to output a sub range of voltage or current to match the device controlled. Analog outputs shall use 8 bit digital to analog conversion.
7. Terminal Unit Controller may be programmed to control what is displayed on zone sensor display. See section 2.4. Terminal Unit Controller may be programmed to show alpha numeric values on zone sensor display in response to program changes or button presses on the zone sensor.
8. Each Terminal Unit Controller shall provide 24 VDC at 250 mA as a source of power for current transducer sensors in the field.

C. Application Specific Terminal Unit Controllers:

1. Application Specific Terminal Unit Controllers shall be completely stand-alone controllers for unitary type controls such as VAV terminal boxes, heat pumps, AC units, unit ventilators, etc. All programs shall be resident in controller for complete stand-alone operation.
2. EEPROM technology shall be used for storage of program parameters such as set points, limits, etc., controllers utilizing a battery for backup of program parameters shall not be allowed.
3. All application specific Terminal Unit Controller units shall have capability to use Digital display zone sensor, or thermistor type zone sensor as listed in section 2.4.

2.21 TEMPERATURE SENSORS:

- A. General: All temperature sensors to be solid state electronic, factory calibrated to within one-half degree F, totally interchangeable. Wall sensors to be housed in enclosure appropriate for application. Duct and well sensors to be electronically identical with housing appropriate for application. Provide appropriate wells for installation by others.
- B. Zone Temperature Sensor:
  - 1. Sensor shall contain push-button bypass switch, electronic sensor, setpoint bias lever, setting adjustable wheel and jack for connection to Digital Display zone sensor for troubleshooting. The operator shall program the time of on after hours override operation from 0.0, no override, to 9.9 hours in 0. hour increments. Push buttons are to remain inactive until zone is in the afterhours mode.
  - 2. Setpoint bias shall be via labeled bias lever. Maximum bias shall be plus or minus 3 degrees F.

2.22 OTHER CONTROL DEVICES:

- A. Dampers: shall be factory sizes nearest to duct size being used and shall have factory filler panels so damper assembly matches duct size. Bearings oil impregnated bronze. Provide parallel blades for positive or modulating mixing service and opposed blade for throttling service, or as specified in sequence. Maximum blade dimension 10 inches. Damper blades and damper frames galvanized. Provide blade edging and side seals for tight shutoff. Dampers shall be equal to Johnson D1200, D1300, or Ruskin CD35. Scribe end of damper drive shaft to indicate blade position.
- B. Damper actuators: Actuators to be pressure independent and have 0-10 volt fully proportional operation. VAV box controllers to have position feedback capability to keep the damper position accurate. Damper actuators shall be sized for 80% of their published load rating including those with pilot positioners. Damper actuators shall be located to distribute operating force equally over full area of damper for uniform positioning of all blades. Quantity and size of actuators for each damper shall be listed on the shop drawings. Where damper operation and fan operation are interlocked, provide control to open damper sufficiently to prevent duct or equipment damage before fan is started. Outside air and relief damper actuators shall also have spring return to closed position.

2.23 SMOKE DETECTORS:

- A. Dual chamber ionization type with duct sampling tubes. UL approved with adjustable sensitivity. Arrange to stop associated fan on presence of smoke. Provide in return duct upstream of outside air connection and filters for all fan systems above 2000 CFM.

2.24 CARBON DIOXIDE SENSORS:

- A. General: Wall-mounted carbon dioxide sensor. Infrared type.
- B. Range and Accuracy: 0 to 2,000 ppm plus or minus 100 ppm. Maximum drift plus or minus 100 ppm per year.



- C. Output Signal: 4 to 20 milliamps linearized.
- D. Calibration Interval: One year.
- E. Ambient Operating Conditions: 32°F to 122°F.

3 EXECUTION

3.01 EXAMINATION:

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- B. Notify the Owners Representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.

3.02 GENERAL INSTALLATION:

- A. Install in accordance with manufacturer's instructions.
- B. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to insure a complete operating system in accordance with the sequences of operation and point schedules.

3.03 LOCATION AND INSTALLATION OF COMPONENTS:

- A. Locate and install components for easy accessibility; in general, mount 60 inches above floor with minimum 3'-0" clear access space in front of units. Obtain Owner Representative's approval on locations prior to installation.
- B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration and high temperatures.
- C. Identify all equipment and panels. Provide permanently mounted tags to all panels.

3.04 INTERLOCKING AND CONTROL WIRING:

- A. Provide all interlock and control wiring. All wiring shall be installed in a neat and professional manner in accordance with Division 16 and all state and local electrical codes.
- B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions.
- C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the Owner's Representative prior to rough-in.
- D. Provide auxiliary pilot duty relays on motor starters as required for control function.

- E. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings; coordinate with electrical contractor.
- F. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring to be installed in a neat and inconspicuous manner per local code requirements.

3.05 DDC POINT SUMMARY:

- A. Provide all Data-base generation.
- B. Displays: System displays shall show all points in the system. They shall be logically laid out for ease of use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.
- C. Run time Totalization: At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
- D. Trend Log: All binary and analog points shall have the capability to be trended.
- E. Alarm Points: All analog inputs (High/Low Limits) and selected digital input alarm points shall be prioritized and routed/auto-dial with alarm message per owner's requirements.
- F. Database Save: Provide back-up database for all stand-alone DDC panels on floppy disk.
- G. Provide all points required in above specification and in point schedule, included in this specification.

3.06 FIELD SERVICES:

- A. Prepare and start DDCS under provisions of this section.
- B. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- C. Provide the capability for off-site monitoring at Control Contractor's local or main office. At a minimum, off-site facility shall be capable of system diagnostics and software download. Owner shall provide Ethernet port and network address setup.
- D. Provide Owner's Representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

3.07 TRAINING:

- A. Provide application engineer to instruct owner in operation of systems and equipment.
- B. Provide basic operator training for a minimum of 3 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs.

- C. Provide training above as required up to twenty-four (24) hours in four (4) six (6) hour blocks as part of this contract. And provide an additional eight (8) hours of training for VRF controls.

3.08 DEMONSTRATION:

- A. Provide systems demonstration under provisions of Section 23 0000.
- B. Demonstrate complete and operating system to Owner's Representative.
- C. Provide certificate stating that control system has been tested and adjusted for proper operation.

4 SEQUENCE OF OPERATION

4.01 CONSTANT VOLUME ROOFTOP UNITS (All):

- A. Operate during occupied hours set by owner's schedule.
- B. Modulate heating, cooling and economizer to maintain set point. Coordinate initial setpoints with BSD staff.
- C. Ventilation: Demand control ventilation based on CO2 in space.
- D. Night set back and morning warm up. Close outside air dampers and operate heating or cooling as required to reach set point.
- E. Alarms: At a minimum provide alarms for high space temperature, low space temperature, and all unit generated alarms.

4.02 GYMNASIUM SYSTEM (EF-10 & 11, UH-1 & 2, DF-1 thru 4):

- A. Exhaust Fans/OSA Intake.
  - 1. Turn on fans on low speed and open OSA damper for cooling when temperature is at or above set point. Increase fan speed if temperature remains above set point.
  - 2. CO2 will override both off and cooling mode to operate fans and fans speed and open OSA dampers to maintain CO2 set point.
  - 3. Modulate fan speed to lowest setting required to maintain set point.
  - 4. Night Low Limit and Morning Warm Up: Fans off and dampers closed during NLL and Morning Warm Up.
- B. Unit Heaters:
  - 1. Operate during occupied hours.
  - 2. Modulate heating to maintain set point.
  - 3. Night Low Limit: Operate as needed during unoccupied hours to maintain NLL set point.

4. Morning Warm Up: Operate prior to occupied hours for space temperature to reach set point by occupied time.

C. Destratification Fans:

1. Operate only during occupied hours
2. Operate when temperature difference between near the ceiling and at 5 feet above the floor is more than 5°F at the highest reading sensors (adjustable).
3. Provide manual on/off override switch in the space to operate all fans.

4.03 VARIABLE REFRIGERANT FLOW SYSTEMS (All):

- A. These systems will operate on factory provided controls, see VRF specifications for sequence, with the following interconnections to the DDC system and graphic interface.

1. Set point control.
2. Scheduling control.
3. Space temperature viewing.
4. Status viewing.
5. Alarms.

4.04 DEDICATED OUTSIDE AIR SYSTEM (AHU-1):

- A. Operate during occupied hours.
- B. Modulate heating to maintain discharge air set point.
- C. Modulate fan speed to maintain space CO2 set point. Airflow to be as shown on schedules.
- D. Operate heat recovery when leaving air temperature and entering air temperature are adequate to provide necessary heating or cooling.

4.05 ELECTRIC WALL HEATERS (All local control only):

- A. Modulate to maintain set point temperature.

4.06 EXHAUST FAN EF-20:

- A. Operate during occupied hours.

5 POINTS LIST

- 5.01 This points list is intended to convey design intent only and is the minimum points required. Additional points will be required and determined by system designer to accomplish a complete and operating system in compliance with this specification and the sequence of operation.

5.02 GENERAL:

- A. Outside air temperature

5.03 CONSTANT VOLUME ROOFTOP UNITS:

- A. Status (on/off)
- B. Status (heating/cooling/economizing)
- C. Supply air temperature
- D. Return air temperature
- E. Space temperature
- F. CO2
- G. Alarms.

5.04 GYMNASIUM SYSTEM:

- A. Unit Heaters
  - 1. Status (on/off)
  - 2. Temperature
- B. Exhaust Fans
  - 1. Fan and Damper Status (on/off)
- C. OSA Intake
  - 1. Damper Status
- D. Destratification Fans
  - 1. Status (on/off/override)
  - 2. Temperature at ceiling.
  - 3. Temperature at floor.
  - 4. Status (on/off)

5.05 VARIABLE REFRIGERANT FLOW SYSTEMS:

- A. Status (on/off)
- B. Status (heating/cooling)
- C. Space temperature
- D. Alarms.

5.06 EXHAUST FANS:

- A. Status (on/off).

END OF SECTION

1 GENERAL

1.01 WORK INCLUDED:

- A. Provide air distribution equipment as specified herein and shown.
- B. Equipment capacity and size shall be as shown.

1.02 QUALITY ASSURANCE:

- A. Ductwork: Comply with requirements of the State Mechanical Specialty Code (latest edition).
- B. Field Wiring: Comply with requirements of Section 23 0000.
- C. Codes: Refer to Section 23 0000.

1.03 SUBMITTALS:

- A. Refer to Section 23 0000.
- B. Provide submittals for the following:
  - 1. Spiral ductwork.
  - 2. Flexible ductwork.
  - 3. Dampers.
  - 4. Grilles, Registers and Diffusers.
  - 5. Louvers.
  - 6. Roof Vents.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Deliver product to site under provisions of Section 23 0000.
- B. Store and protect products under provisions of Section 23 0000.
- C. Store all ductwork, materials on pallets or above grade, protected from weather, dirt, mud and other construction dust.
- D. Remove all accumulated dust, dirt, etc. from each duct section as it is being installed.

2 PRODUCTS

2.01 DUCTWORK:

- A. Galvanized steel sheet metal: Metal gauges, joints and reinforcement in accordance with mechanical Code, ASHRAE and SMACNA tables and recommendations.

- B. Spiral Seam Duct: Round and flat oval spiral seam duct shall be manufactured of galvanized steel sheet metal with spiral lock seam. Matching fittings shall be manufactured of galvanized steel with spot welded seams. United Sheet Metal, Semco, Rolock, Metco or accepted substitute.
- C. Flexible Ductwork: Insulated low pressure flexible duct, factory fabricated assembly consisting of a zinc coated spring steel helix, seamless inner liner, wrapped with a nominal one inch thick, one pound per cubic foot density fiberglass insulation. The assembly shall be sheathed in a vapor barrier jacket, factory sealed at both ends of each section assuring the vapor resistance of each section as well as the completed installation. The composite assembly, including insulation and vapor barrier, shall meet the Class I requirements of NFPA 90A and be labeled by UL with a flame spread rating of 25 or less and a smoke developed rating of 50 or under. The duct shall have factory sealed double air seal (interior and exterior), to assure an airtight installation. Genflex, Wiremold, Thermaflex or accepted substitute.
- D. Metal Round and Flat Oval Spiral Sound-Attenuating Ductwork: duct systems with acoustical attenuation properties equal or greater than those for duct type K27-P by United Sheet Metal. Fittings: Factory fabricated with slip joint construction of the same construction as the duct. Provide 45-degree lateral wye takeoffs. Provide duct sealer for sealing field joints for round spiral lock seam duct systems. United Sheet Metal K-27, Semco, Rolock, Metco or accepted substitute.

2.02 ACOUSTICAL DUCT LINING:

- A. Line ducts with 1 inch thick, Johns Manville "Permacote Linacoustic" R-300, meeting NFPA 90A requirements for maximum flame spread and smoke developed. Gustin Bacon, Owens Corning or accepted substitute. Air side surface protected with acrylic coating, impervious to dust and dirt, will not support microbial growth, rated for 5,000 FPM air velocity. Mechanically attach lining to sheet metal duct with Johns Manville Grip Nails or Gramweld welding pins. Apply fire retardant type adhesive similar to Johns Manville No. 44 adhesive, Benjamin Foster 81-99, Insul-Coustic 22 or 3M equivalent on all leading edges, joints and seams.

2.03 DUCT SEALING:

- A. Aluminum bonded to aluminized mylar reinforced with fiberglass mesh backing an elastomeric pressure sensitive adhesive specifically formulated for adhesion to galvanized metal. Hardcast "AFG-1402" with "HD-181" degreaser or accepted substitute.
- B. Two-part sealing system with woven fiber, mineral gypsum impregnated tape and non-flammable adhesive. Hardcast "DT-5300 tape and "RTA-50" adhesive or United "Uni-Cast" system or accepted substitute.
- C. Duct Joints for Sheet Metal Ducts: "Ductmate System" by Ductmate Industries, Inc., for making transverse rectangular and round duct joints. Ward Duct Connectors, Inc., MEZ, Lockformer TDC or accepted substitutes.



2.04 ACCESSORIES:

- A. Manual Volume Dampers: Construct of material two gauges heavier than duct in which installed; single plate up to 12 inches wide; multiple over 12 inches wide. Hem both edges 1/2 inch and flange sides 1/2 inch. Provide regulator extension through sheet rock ceiling with concealed adjustable cover. Use Young, DuroDyne or accepted substitute damper accessories.
- B. Backdraft Dampers: Connected, felt-edged aluminum blades set in 14 gauge or heavier steel frame; brass, nylon or teflon bearings; equip with spring helper with tension adjustment feature or with adjustable counterweight and adjust to open when not more than 0.10-inch wg pressure is applied. Ruskin CBD-4, Pacific Air Products, Air Balance, Controlair or accepted substitute.
- C. Opposed Blade Damper: Install opposed blade dampers where shown. Young No. 817 or accepted substitute.
- D. Fire Dampers: Constructed and installed in accordance with NFPA, UMC and UL labeled. Provide dynamic fire dampers with 1-1/2-hour fire protective rating; locate fusible links for easy service or replacement; provide access panels of proper fire rating as required. Fusible links to be rated at 160°F. Fire damper assembly to be selected at a maximum pressure drop of 0.05 inches w.g. Provide dampers to maintain free area through damper same as unobstructed run of duct. American Warming, Dowco, Krueger, Ruskin, Phillips-Aire, Tuttle and Bailey, Prefco, Greenheck, Ultrasafe, Safe Air, National Controlled Air, Air Balance or accepted substitute.
- E. Combination Air-Smoke-Fire Dampers: Constructed and installed in accordance with NFPA, UMC and UL labeled. Fire damper functions to be as specified previously. Provide with factory mounted 120-volt operating motor where utilized as smoke damper. Smoke damper to be shaft operated. Prefco, Safe Air, National Controlled Air, Air Balance, Greenheck, Ruskin or accepted substitute.
- F. Access Doors: In sheet metal work, hollow core double construction of same or heavier gauge material as duct in which installed. Use no door smaller than 12 inches by 12 inches for simple manual access or smaller than 18 inches by 24 inches where personnel must pass through infrequently. Use 24 inches by 60 inches minimum for filters and more frequent maintenance. Use Ventlok or approved hinges and latches on all doors; 100 series hinges and latches on low pressure system doors up to 18 inches maximum dimension, 200 series on larger low-pressure system doors and 333 series on high pressure systems. Construct doors up to 18 inches maximum dimension with one-inch overlap fit and gasket with 3/4 inch by 1/8-inch sponge rubber; fit larger doors against 1-1/2 inches by 1/8-inch flat stock or angle frame and gasket with 3/4 inch by 1/8-inch sponge rubber or felt. Door swing to be opposite airflow.
- G. Fan and Air Handling Unit Flexible Connections: Install neoprene impregnated fiberglass connections in ductwork at all rotating equipment. Ventglass, DuroDyne or accepted substitute.
- H. Control Dampers: Provide automatic control dampers as indicated. Airfoil, multi-blade type with a maximum blade width of 48 inches. Blades to be interlocking, minimum 16 gauge. Continuous shafts to provide for "tracking" of all blades. Maximum air leakage of 4 CFM per sq. ft. at 1.0 inches water gauge. Provide damper actuator. Alerton, Honeywell, Johnson Control, Seimens, Trane or accepted substitute.

2.05 GRILLES, REGISTERS AND DIFFUSERS:

- A. Description: Provide grilles, registers and diffusers as shown.
- B. Finish:
  - 1. Steel: Baked-on white enamel finish, or flat white prime coat, factory applied. Verify the exact finish type with architectural drawings.
  - 2. Aluminum: Clear anodized.
- C. Manufacturers: Air Devices, Anemostat, Carnes, Krueger, Tuttle & Bailey, Price Co., Metalaire are accepted substitutes where Titus model numbers only are listed.

2.06 LOUVERS:

- A. Frame and sill styles compatible with adjacent substrate, specifically manufactured to fit into construction openings with accurate fit and adequate support for weatherproof installation. Construct of aluminum extrusions, ASTM B221. On inside face of exterior louvers, provide aluminum screen mounted in frames. Blades on 4-inch centers with rain stop design.
- B. Manufacturers: American Warming and Ventilating, Inc., Pottorff, United Metal Products, Carnes, Cesco, Industrial Louvers, Inc., Louvers & Dampers, Inc., Ruskin, Greenheck or accepted substitute.

2.07 ROOF VENTS:

- A. Gravity Type: Furnish and install to match roof exhaust fan hoods.
- B. Turbine Type: Turbine Roof Ventilator Model RT-30, Breidert or accepted substitute

3 EXECUTION

3.01 LAYOUT AND COORDINATION:

- A. Site Examination: Before starting work, carefully examine site and all contract drawings. Become thoroughly familiar with conditions governing work on this project.
- B. Utility Locations: The location of all utilities, wires, conduits, pipes, ducts, or other service facilities is shown in a general way only on the drawings.

3.02 INSTALLATION:

- A. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube opening 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 materials inside a metal ring.
- B. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

- C. Provide manual volume dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts for air balancing. Use splitter dampers only where shown. Location of all volume dampers are not necessarily shown on the drawings.
- D. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- E. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where shown.
- F. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 12 inches x 12 inches size for hand access, 18 inches x 24 inches size for shoulder access and as indicated. Install necessary access openings and covers for cleaning, wiring or servicing motors, fire dampers, filters, fans, both entering and leaving air sides of coils, and to other equipment located within or blocked by ductwork.
- G. Support: Install ductwork with 1 inch wide 16-gauge cradle hangers not more than 8 feet c/c or as required by code. Support terminal units independent of adjacent ductwork. Attach to available building construction as per good practices for materials involved. Exposed ductwork shall be supported by closed cradle strap suspended from 3/8-inch threaded rod.
- H. Connection Fittings: Round connections to rectangular ducts manufactured sheet metal "spin-in" fittings. Genflex, Wiremold, Thermaflex, Glassflex, Clevepak, Manville, or accepted substitute.
- I. Elbows and Fittings: Construct elbows with throat radius equal to duct width in plane or turn or make them square and provide double wall, air foil turning vanes.
- J. Fittings: Make transitions and take-offs as shown. Provide volume dampers and splitter dampers as shown and as specified.
- K. Sleeves: Provide galvanized sheet metal plaster ring around ductwork penetrating exposed finished walls. Sleeve and flash all duct penetrations through exterior walls in an air tight and weatherproof manner.
- L. Plenums: Construct sheet metal plenums and partitions of not lighter than 18-gauge galvanized steel and reinforce with 1-1/2 inch by 1/2 inch by 1/8-inch angles as required to prevent drumming or breathing.
- M. Acoustical Duct Lining: Acoustically line all outside air ducts and plenums, all fan unit intake and discharge plenums, all ductwork indicated as lined on the Drawings.
- N. Manual Volume Dampers: Location of all volume dampers are not necessarily shown. Provide a minimum of one volume damper in each supply, return or exhaust branch.
- O. Duct Insulation: Insulate all ductwork per Section 23 0700 as requiring insulation. In addition, all ductwork indicated in Table No. 13-S of the Structural Specialty Code and Fire and Life Safety Regulations shall be insulated or lined.

- P. Flexible Ductwork: Support hanger or saddle material in contact with duct shall be of sufficient width to prevent any restriction of the internal diameter of the duct, and in no case less than 1 inch wide. Maximum sag to be 1/2 inch per foot of spacing between supports. Flexible ducts shall be installed in a fully extended condition free of kinks with no direction change to exceed 90 degrees, using only the minimum length required to make the connection with a maximum length of 24 inches. Sheet metal collars to which the duct is attached shall be a minimum of 2 inches long. Flexible duct shall be inserted into the collar a minimum of 1 inch and inner liner secured with a minimum 1/2-inch-wide positive locking steel strap. In ducts larger than 12 inches diameter, steel strap must be secured by beading. Reshape insulation and vapor barrier over duct and collar and secure using drawband. Attachment of joints is similar using a minimum of 4 inches long collar.
- Q. Exposed ductwork joints shall be sealed with "Ductmate System".
- R. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- S. Fiberglass Duct Installation: All fabrication to be in accordance with SMACNA Fibrous Glass Manual, Duct Construction Standards.

3.03 ADJUSTING AND CLEANING:

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

END OF SECTION

1 GENERAL

1.01 WORK INCLUDED:

- A. Provide equipment as specified herein and shown on the Drawings.
- B. Equipment capacity and size as indicated in the equipment lists on the Drawings.

1.02 QUALITY ASSURANCE:

- A. Air Handling Equipment: Rated in accordance with AMCA certified rating procedures and AMCA labeled.
- B. Air Conditioning and Refrigeration Equipment Rating: Rated in accordance with ARI certified rating procedures and AMCA labeled.
- C. Codes: Refer to Section 23 0000.

1.03 SUBMITTALS:

- A. Submit product data under provisions of Section 23 0000.
- B. Submit product data for manufactured products and assemblies required for this project.
- C. Indicate electrical service and duct connections on product data.
- D. Submit manufacturer's installation instructions under provisions of Section 23 0000.
- E. Provide Submittals for the following:
  - 1. Air Conditioning Units.
  - 2. Air Handling Unit Refurbishment
  - 3. Destratification Fans
  - 4. Roof Exhaust Fans
  - 5. Condensing Units
  - 6. Fan Coil Units
  - 7. Rooftop AC Units

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Deliver product to site under provisions of Section 23 0000.
- B. Store and protect product under provisions of Section 23 0000.
- C. Store insulation in original shipping container with labeling in place. Do not install damaged insulation.

1.05 OPERATION AND MAINTENANCE DATA:

- A. Submit operation and maintenance data under provisions of Section 23 0500.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

2 PRODUCTS

2.01 PACKAGED ROOFTOP AIR CONDITIONING UNITS:

- A. Manufacturers: Trane, Carrier, Daikin or approved substitution.
- B. Performance: Unit shall be selected within +/-5% of cooling and heating capacity scheduled. Unit shall be provided EER, IPLV, fan BHP efficiencies at or better than scheduled values.
- C. Unit: Single piece packaged rooftop combination heating and cooling unit. Unit factory assembled, piped, charged with refrigerant, wired and tested. Factory run tested to include the operation of all fans, compressors, heat exchangers, and control sequences. Factory adhere labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
- D. Cabinet: Zinc coated galvanized steel to be finished with weather-resistant enamel finish. Unit surface shall withstand 600 hours in a salt spray test in compliance with ASTM B117. Unit to have downflow supply and return with duct connections made fully inside roof curb. The unit base shall have provisions for crane lifting lugs. Unit to include outside air intake hood. Roof panels shall be sloped to provide positive drainage of rain water / melting snow away from the cabinet.
- E. Service Access: Access panels shall be hinged or quick lift out with no more than two screws and provide a water and air tight seal.
- F. Supply Fan: Forward curved, double width, double inlet, centrifugal type supply fan with self-aligning, grease lubricated ball or sleeve bearings with permanent lubrication fittings. Belt drive with fixed pitch sheaves on units 3 tons and larger, direct drive allowed only on units 2.5 tons and smaller. Provide one set of replacement sheaves if needed by air balancer. Provide thermal overload protection on motor.
- G. Exhaust Fan: Units 6 tons and larger shall be provided with exhaust fan to assist in controlling building static pressure. Exhaust fan is for duct installation on horizontal discharge units. Exhaust fan shall be mounted and integrally wired on downflow units. Exhaust fan shall be on whenever outside air damper is greater than 25 percent.
- H. Gas Heating Section: Completely assembled and wired gas fired heating system with stainless steel heat exchanger, electronic ignition, centrifugal combustion blower, continuous flame safety, automatic gas valve and manual gas shut-off valve. Designed and tested for use constant airflow with entering air down to 45 degrees. Two-stage natural gas heating when heating output is greater than 140 MBH.

- I. Refrigeration System: Direct drive hermetic scroll compressors with centrifugal type oil pumps. All compressors to include internal temperature and current-sensitive motor overloads. Crankcase heaters to be included on units 6-tons and above. Compressors shall be isolated from casing with suitable vibration isolation. Direct drive propeller condenser fans to include permanently lubricated bearings and built-in thermal overload protection. Aluminum fin DX cooling coil with moisture carryover management system. Condensate pan shall be sloped & pitched with not standing water. Condenser coil with plate type aluminum fin, maximum 16 fins per inch for cleanability. Refrigeration system suitable for ambient operation down to 0 degrees F in case of economizer failure. Refrigeration system suitable for ambient operation up to 125 deg F. Evaporator and condenser coils leak tested to 600psi.
- J. Economizer: Provide factory installed fully integrated 100% modulating outside air economizer with return and outside air dampers. Damper operator shall be spring return and close outside air damper on power loss. Economizer controls shall be factory installed JADE controllers that utilize outdoor dry bulb temperature to enable economizer operation. Outside air shall be locked out during unoccupied and morning warmup conditions. Provide adjustable minimum position control.
- K. Electrical: Units shall be UL listed and label as a complete assembly. Provide single control panel with weatherproof control panel, single point electrical connection, suitable overload protection for each branch circuit, contactors for each motor & compressor, fused control power transformer. Provide wiring diagrams, affixed to access door.
- L. Controls: Factory mounted Johnson Controls Inc. controls to include devices and wiring necessary for unit operation on a standalone basis for service checkout and operation before control installation is complete. This system shall consist of contactors, transformers, two-minute supply fan anticycle timer, compressor min ON and OFF anticycle timers, condenser fan anticycle timers, heat anticycle timers, and refrigeration safeties factory wired and tested. Controls shall provide fully integrated, dry bulb initiated, economizer control that allows compressor operation to supplement free cooling. Unit control shall interface with thermostat or controller specified under division 23 0923.
- M. Unit Options:
  - 1. Roof Curb: 14-inch-high galvanized steel curb with gaskets and nailer strip, manufactured in accordance with the National Roofing Contractors Association guidelines for rooftop equipment support.
  - 2. Filters: Filter rack with MERV 8 filters minimum. MERV 13 filters optional, see schedule.

2.02 CENTRIFUGAL DIRECT DRIVE ROOF EXHAUST FANS:

- A. Spun aluminum exhaust fans shall be direct drive type. The fan wheel to be centrifugal forward curved or backward inclined, constructed of aluminum and include a wheel cone matched to the inlet cone. Wheels to be statically and dynamically balanced. The fan housing to be constructed of heavy gauge aluminum with a rigid internal support structure and a birdscreen.

- B. Electronically Commutated Motors to be mounted out of the airstream on vibration isolators. Fresh air for motor cooling to be drawn into the motor compartment through a space between the fan shroud and the motor cover. Motors to be readily accessible for maintenance.
- C. A disconnect switch to be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A conduit chase to be provided through the base to the motor compartment for ease of electrical wiring. Provide a speed control controller.
- D. All fans to bear the AMCA Certified Ratings Seal for sound and air performance.
- E. Each fan to bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number.
- F. Manufacturers: Greenheck, Carnes, Cook, Penn, ILG, Breidert, Acme or accepted substitute.

2.03 DESTRATRIFICATION FANS:

- A. Manufacturers
  - 1. Airius, Entrematic or approved substitute.
- B. Performance: Coordinated design of housing, stator and motor shall provide columnar laminar airflow to produce a minimum of 100 fpm at center of column at grade level when installed within 2'-0" of ceiling.
- C. Housing: The fan housing shall be made of PC/ABS resin, rated 5VA for flame resistance.
  - 1. Housing color:
    - a. PMS Cool Gray 2C (off white)
- D. Safety Cable: Supply with 6'-0" steel cable fastened to seismic restraint point integrated into housing.
- E. Motor Mounting: Enclosed in housing, above stator.
- F. Stator: The fan shall be equipped with a patented multiple-vane stator coordinated with fan design for maximizing columnar laminar flow.
- G. Certification: UL Standard 507 for Safety Electric Fans, CAN/CSA C22.2#60335-1 and UL 94 5VA as certified by nationally recognized testing laboratory. Acceptable laboratories include ETL, UL or other nationally recognized testing laboratories.
- H. Identification: Permanently affixed manufacturer's nameplate including the following: Model Number, Serial Number, Motor Power Specifications, Safety Marks: ETL (. )
- I. Power Cord: 6 foot, with a standard 3-prong plug.
- J. Motor: Electronically commutated.

2.04 CONDENSING UNITS:



- A. Completely factory assembled, piped, and wired. Fabricate the casing of galvanized steel, bonderized and finished with baked enamel. Furnish the unit with a direct drive propeller type fans arranged for horizontal discharge. The motors to have inherent protection, be of the permanently lubricated type and resiliently mounted for quiet operation. Provide each fan with a raised wire guard to prevent contact with moving parts.
  - 1. The compressors of the high performance, serviceable rotary type with crankcase heater, accumulator and internal thermal overloads. Internally isolate the compressors with rubber mounts so as to avoid the transmission of vibration. Refrigerant flow from the condenser to be controlled by means of capillary tube.
  - 2. The condenser coil of nonferrous construction with smooth late fins bonded to copper tubing. The tubing to have inner grooves for high efficiency heat exchange. Protect the coil with an integral metal guard.
  - 3. Control the unit by the microprocessor located in the matching indoor unit. The outdoor unit to have the ability to provide power for the matching indoor unit.
  - 4. Refrigerant Piping: Type "L" copper with brazed joints approved. A pre-charged refrigerant tubing set may be provided with the system by the manufacturer.
- B. Manufacturers: Trane, Carrier, Daikin or approved substitute.

2.05 DIRECT EXPANSION COOLING COIL:

- A. Copper tube aluminum fin DX cooling coil with moisture carryover management system and drain pan.

2.06 FAN COIL UNITS:

- A. General: Draw-through unit with heating water coil, one or more centrifugal fans with motors, speed control mounted on unit, and 18-gauge galvanized steel casing. Insulate interior of casing with ½-inch fiberglass. Provide belt drive where scheduled.
- B. Coils: ½-inch OD copper tubes with aluminum fins mechanically bonded to the tubes. 5/8-inch OD male sweat fittings. Coils are leak tested at 350 PSIG minimum air pressure, suitable for working pressures up to 250 PSIG with air vents. Prepipe coils with 2-way valves and shutoff valve on supply and a balancing and a shutoff valve on return pipe.
- C. Motors: Electronically commutated motor.
- D. Primary and Secondary Drain Pan: 18-gauge galvanized steel, interior surfaces insulated with fire retardant closed cell foam, drain connection 7/8-inch OD male sweat fitting. Pitch the drain pan for positive drainage. Provide overflow drain connection.
- E. Junction Box: Prewire control components to junction box.
- F. Filters: 1-inch glass fiber throwaway.

- G. Control through DDC system.
- H. Disconnect: Provide a unit mounted disconnect switch.
- I. Manufacturers: Daikin, Trane, First Co. Carrier or approved substitute.

3 EXECUTION

3.01 EXAMINATION:

- A. Verify that building is ready to receive work and opening dimensions are as illustrated by the manufacturer.
- B. Verify that proper power supply is available.

3.02 INSTALLATION:

- A. Install in accordance with manufacturer's instructions and applicable code.
- B. Lubricate all moving and rotating parts in accordance with manufacturer's recommendation prior to start-up.
- C. All roof mounted mechanical equipment shall be supported and seismically anchored on leveled, flashed and counterflashed curbs anchored to resist seismic forces and suitable for the roof construction. Minimum curb height shall be 12 inches above the roof unless otherwise noted. Flashing into the roof is specified in another Section.
- D. Make all electrical and duct penetrations for each equipment within the curb unless shown otherwise on the Drawings. Piping and electrical conduit routed above and across the roof shall be supported on flashed and counterflashed curbs with pipe guides anchored to the curbs in "pitch pockets." Submit shop drawings on other arrangements for approval.

3.03 FILTERS:

- A. New filters shall be installed in units prior to air balancing and project acceptance.

END OF SECTION

1 GENERAL

1.01 SYSTEM DESCRIPTION:

- A. The variable capacity, heat pump heat recovery air conditioning system including all equipment, piping, accessories and controls for a fully operational system.

1.02 SUBMITTALS:

- A. All Products.

1.03 QUALITY ASSURANCE:

- A. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
- D. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.
- E. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Unit shall be stored and handled according to the manufacturer's recommendation.

1.05 CONTROLS:

- A. The control system shall consist of a low voltage communication network of unitary built-in controllers with on-board communications and a web-based operator interface. A web controller with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
- B. All controls shall interface with school and district wide Johnson Control system seamlessly via BacNet. VRF supplier is responsible for full control of the VRF system including but not limited to scheduling, temperature, alarms, night low limit, morning warm up, etc. Input for scheduling and set points will be from Johnson control system. VRF will output alarms to Johnson Control system.
- C. System controls and control components shall be installed in accordance with the manufacturer's written installation instructions.
- D. Furnish energy conservation features such as optimal start, night setback, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.

- E. System shall provide direct and reverse-acting on and off algorithms based on an input condition or group conditions to cycle a binary output or multiple binary outputs.
- F. Provide capability for future system expansion to include monitoring and use of occupant card access, lighting control and general equipment control.
- G. System shall be capable of email generation for remote alarm annunciation.
- H. Control system start-up shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in Mitsubishi Electric controls system configuration and operation. The representative shall provide proof of certification for Mitsubishi Electric Controls Applications Training indicating successful completion of no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals. This service shall be equipment and system count dependent and shall be a minimum of one (1) eight (8) hour period to be completed during normal working hours.

1.06 WARRANTY:

- A. The system shall be covered by the manufacturer's limited warranty for a period of one (1) year parts and seven (7) year compressor to the original owner from date of installation.
- B. In addition, the compressor shall have a manufacturer's limited warranty for a period of ten (10) years to the original owner from date of installation.
- C. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.

2 PRODUCTS

2.01 OUTDOOR UNIT:

- A. General: Outdoor unit shall be equipped with multiple circuit boards that interface to the controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.
  - 1. Outdoor unit shall have a sound rating no higher than 61 dB(A) individually or 64 dB(A) twinned. Units shall have a sound rating no higher than 51 dB(A) individually or 54 dB(A) twinned while in night mode operation. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
  - 2. Both refrigerant lines from the outdoor unit to the BC (Branch Circuit) Controller (Single or Main) shall be insulated in accordance with the installation manual.
  - 3. The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.
  - 4. There shall be no more than 3 branch circuit controllers connected to any one outdoor unit.

5. Outdoor unit shall be able to connect to up to 50 indoor units depending upon model.
  6. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
  7. The outdoor unit shall have a high-pressure safety switch, over-current protection, crankcase heater and DC bus protection.
  8. The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have total refrigerant tubing length of 1804-3100 feet. The greatest length is not to exceed 541 feet between outdoor unit and the indoor units without the need for line size changes or traps.
  9. The outdoor unit shall be capable of operating in heating mode down to -4°F ambient temperatures or cooling mode down to 23°F ambient temperatures, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.
  10. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Unit must defrost all circuits simultaneously in order to resume full heating more quickly. Partial defrost which may extend "no or reduced heating" periods shall not be allowed.
- B. Unit Cabinet:
1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
- C. Fan:
1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
  2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
  3. All fan motors shall be mounted for quiet operation.
  4. All fans shall be provided with a raised guard to prevent contact with moving parts.
  5. The outdoor unit shall have vertical discharge airflow.
- D. Refrigerant:
1. R410A refrigerant shall be required for outdoor unit systems.
  2. Polyolester (POE) oil shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

E. Coil:

1. The outdoor heat exchanger shall be of zinc coated aluminum construction with turbulating flat tube construction.
2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
3. A stainless-steel pipe connects the aluminum coil to copper piping.
4. The coil shall be protected with an integral metal guard.
5. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
6. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

F. Compressor:

1. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non-inverter-driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. A crankcase heater(s) shall be factory mounted on the compressor(s).
3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 15%-5% of rated capacity, depending upon unit size.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.
6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

G. Controls:

1. The outdoor unit shall have the capability of up to 8 levels of demand control for each refrigerant system

H. Electrical:

1. The outdoor unit electrical power shall be 460 volts, 3-phase, 60 hertz.
2. The outdoor unit shall be capable of satisfactory operation within voltage limits of 414-506 volts.
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.02 BRANCH CIRCUIT (BC) CONTROLLERS FOR R2-SERIES SYSTEMS:

A. General:

1. The BC (Branch Circuit) Controllers shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices with no subcooling risk bubbles in liquid supplied to LEV and are not allowed.
2. The BC (Branch Circuit) Controllers shall be specifically used with R410A R2-Series systems. These units shall be equipped with a circuit board that interfaces to the controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity. The BC Controller shall be suitable for use in plenums in accordance with UL1995 ed 4.

B. BC Unit Cabinet:

1. The casing shall be fabricated of galvanized steel.
2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
3. The unit shall house two tube-in-tube heat exchangers.

C. Refrigerant:

1. R410A refrigerant shall be required.

D. Refrigerant Branches:

1. All BC Controller refrigerant pipe connections shall be brazed or flared.

E. Refrigerant valves:

1. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
2. Each branch shall have multiple two-position valves to control refrigerant flow.
3. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
4. Linear electronic expansion valves shall be used to control the variable refrigerant flow.

F. Integral Drain Pan:

1. An Integral resin drain pan and drain shall be provided

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 Hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 187-228 (208V/60Hz) or 207-253 (230/60Hz).
3. The BC Controller shall be controlled by integral microprocessors
4. The control circuit between the indoor units and outdoor units shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.03 INDOOR UNITS:

A. General:

1. The PKFY shall be a wall-mounted indoor unit section and shall have a modulating linear expansion device and a flat front. The PKFY shall be used with the R2-Series outdoor unit and BC Controller, Y-Series outdoor unit, or S-Series outdoor unit. The PKFY shall support individual control using M-NET DDC controllers.

B. Indoor Unit:

1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. All casings, regardless of model size, shall have the same white finish
2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
3. There shall be a separate back plate which secures the unit firmly to the wall.

D. Fan:

1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).



4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.
- E. Filter:
1. Return air shall be filtered by means of an easily removable, washable filter.
- F. Coil:
1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
  2. The tubing shall have inner grooves for high efficiency heat exchange.
  3. All tube joints shall be brazed with phos-copper or silver alloy.
  4. The coils shall be pressure tested at the factory.
  5. A condensate pan and drain shall be provided under the coil.
  6. Both refrigerant lines to the PKFY indoor units shall be insulated in accordance with the installation manual.
- G. Electrical:
1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
  2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)
- H. Controls:
1. This unit shall use controls provided by Mitsubishi Electric Cooling & Heating to perform functions necessary to operate the system. Please refer to Part 4 of this guide specification for details on controllers and other control options.
  2. The unit shall be able to control external backup heat.
  3. The unit shall have a factory built in receiver for wireless remote control
  4. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
  5. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
  6. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
  7. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

2.04 CEILING-RECESSED CASSETTE INDOOR UNIT:

A. General:

1. The unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet:

1. The cabinet shall be a compact 22-7/16" wide x 22-7/16" deep so it will fit within a standard 24" square suspended ceiling grid.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
3. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.

C. Fan:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of three (3) speeds, Low, Mid, and High.
4. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
5. The auto air swing vanes shall be capable of automatically swinging up and down for uniform air distribution.

D. Filter:

1. Return air shall be filtered by means of a long-life washable filter.

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.

5. A condensate pan and drain shall be provided under the coil.
6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 19-3/4" inches above the condensate pan.
7. Both refrigerant lines to the PLFY indoor units shall be insulated in accordance with the installation manual.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

G. Controls:

1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system.
2. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
3. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
4. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
5. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

2.05 CONSOLE INDOOR UNIT:

A. General:

1. Floor-standing indoor section with and have a modulating linear expansion device. The PFFY shall be used with the R2-Series outdoor unit and BC Controller, Y-Series outdoor unit, or S-Series outdoor unit. The PFFY shall support individual control using M-NET DDC controllers.

B. Indoor Unit:

1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet, Exposed:

1. The casing shall have a beige Acrylic paint finish.

D. Unit Cabinet, Recessed:

1. The casing shall have a galvanized sheet metal finish.

E. Fan:

1. The indoor unit fan shall be an assembly with one or two Sirocco fan(s) direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of two (2) speeds, High and Low.

F. Filter:

1. Return air shall be filtered by means of an easily removable washable filter.

G. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. Both refrigerant lines to the PFFY indoor units shall be insulated in accordance with the installation manual.

H. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

I. Controls:

1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system. Please refer to Part 5 of this guide specification for details on controllers and other control options.
2. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

3. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
4. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

2.06 CEILING-SUSPENDED INDOOR UNIT:

A. General:

1. Ceiling-suspended indoor unit section and have a modulating linear expansion device. The PCFY shall be used with the R2-Series outdoor unit and BC Controller(s), Y-Series outdoor unit, or S-Series outdoor unit. The PCFY shall support individual control using M-NET DDC controllers.

B. Indoor Unit:

1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. The unit shall have an auto-swing function for the horizontal vane. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. The casing shall have a white finish.

D. Fan:

1. The indoor unit fan shall be an assembly with two, three, or four Sirocco fan(s) direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of four (4) speeds, Low, Mid1, Mid2, and High, and Auto fan function.

E. Filter:

1. Return air shall be filtered by means of an easily removable, washable filter.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.

5. A condensate pan and drain shall be provided under the coil.
6. Both refrigerant lines to the PCFY indoor units shall be insulated in accordance with the installation manual.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)

H. Controls:

1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system. Please refer to Part 5 of this guide specification for details on controllers and other control options.
2. Units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output
3. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
4. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
5. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.
6. Manufacturer to provide drain pan level sensor powered by a 20-year life lithium battery. Sensor shall require no external power for operation and shall have an audible indication of low battery condition.
7. The drain pan sensor shall provide protection against drain pan overflow by sensing a high condensate level in the drain pan. Should this occur the control shuts down the indoor unit before an overflow can occur. A thermistor error code will be produced should the sensor activate indicating a fault which must be resolved before the unit re-starts.

2.07 CONTROLS:

A. General:

1. The CITY MULTI Controls Network (CMCN) shall be capable of supporting remote controllers, centralized controllers, an integrated web-based interface, graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®.

B. Electrical Characteristics:

1. General:

- a The CMCN shall operate at 30VDC. Controller power and communications shall be via a common non-polar communications bus.

2. Wiring:

- a Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor Part 3 Execution

3 EXECUTION

3.01 INSTALLATION:

- A. Follow all manufactures installation instructions.

3.02 DEVIATIONS FROM PLANS:

- A. Any deviations from pipe sizes, lengths, routing, etc. from the plans or shop drawing selections will require reselection and resizing using manufacturer's approved software.

3.03 TRAINING:

- A. Provide 16 hours on site training for BSD staff. All training will be videoed, and a full training manual provided.

END OF SECTION

1 GENERAL

1.01 REQUIREMENTS

- A. This section specifies the requirements necessary to furnish and/or install electrical equipment and systems. Electrical systems and equipment required for this work includes labor, materials, equipment, and services necessary to complete installation of electrical as shown on Drawings, specified herein or required for a complete operable facility, and not specifically described in other Sections of these Specifications.
- B. The contract price will be payment in full for furnishing all labor, materials, tools, equipment and incidentals necessary to complete the Work as specified.
- C. Connect equipment, whether furnished by Owner or other Divisions of the Contract, and ensure equipment is electrically complete and operational unless otherwise noted.
- D. Provide raceways, wires, cables, connector, boxes, devices, finish plates and the like for a complete and operational electrical system.
- E. Coordination of work:
  - 1. Conduct Work in a manner to cooperate with all other trades for proper installation of all items of equipment. Consult the Drawings of all other trades or crafts to avoid conflicts with cabinets, counters, equipment, structural members, etc. In general, the architectural drawings govern, but resolve conflicts with the Engineer/Owner prior to rough-in.
  - 2. Verify the physical dimension of each item of electrical equipment to fit the available space. Coordination of the equipment to fit into the available space and the access routes through the construction is the Contractor's responsibility. Coordinate routing with facility representative.
  - 3. Coordinate rough-in and wiring requirements for all equipment with equipment installer and equipment supplier. Make installation in accordance with rough-in and wiring diagrams provided by equipment supplier for Contractor's use. Report immediately to Architect and Owner's Authorized Representative, any deviation between Contract Documents and actual equipment requirements.
  - 4. Coordinate all aspects of the installation and other utility services with the appropriate serving utility. No additional compensation will be allowed the Contractor for connection fees or additional Work or equipment not covered in the Drawings or Specifications that are a result of policies of the serving utility.
  - 5. In the event of a conflict between the Specifications and/or Drawings and the local or regional regulatory rules/codes/standards, in addition to the applicable codes and/or standards, the more stringent requirement prevails.
- F. Electrical Drawings:



1. The Drawings accompanying these Specifications are design drawings and generally are diagrammatic - indicating approximate locations of equipment, devices, wiring and/or associated hardware and systems. They do not show every detail, device, wire and/or associated hardware and system which may be required for installation to complete the system. Minor deviations in methods or arrangements to suit construction conditions are permissible.
2. Drawings are diagrammatic with symbols representing electrical equipment, outlets, luminaires, and wiring.
3. Electrical symbols indicating wiring and equipment shown in the Contract Documents are included in the Contract unless specifically noted otherwise.
4. Examine the entire set of Drawings to avoid conflicts with other systems. Determine exact route and installation of electrical wiring and equipment with conditions of construction.
5. The Drawings govern in matters of quantity, the Specification in matters of quality. In event of conflict on Drawings or in the Specifications, the greater quantity and the higher quality apply. Submit request for clarification if conflict arises.
6. Should the Electrical Documents indicate a condition conflicting with the governing codes and regulations, refrain from installing that portion of the work until clarified by Architect.

G. Training

1. For each distinct electrical system provide training for the building owner and their staff. Coordinate detail and level of training required for each system to ensure owner is satisfied. At minimum provide four hours of training per distinct system with factory trained representatives as applicable, ensure training includes but is not limited to training documentation, hands on instruction, examples, and Q&A. Coordinate with owner to schedule training time.
2. Provide minimum of 1-year of 24/7 phone support for system operation as part of system training. 1 year of support starts at time of owner's final acceptance of the systems. Ensure phone support is qualified and available to answer and work through system training questions as needed to meet the satisfaction of the owner. The phone support is in addition to any warranty or other rights guaranteed to the owner.

1.02 SUBMITTALS

- A. Provide digital submittal documents of original document quality, clearly marked to indicate equipment options and accessories to comply with the contract documents. Photocopies of hand marked documents will be rejected and returned for re-submittal.
- B. Provide all required submittal data in PDF "e-book" format on DVD or make data available to client via online secure storage with minimum of 1-year access to online storage. Organize digital submittals by specification section and separate

within separate folders labeled with applicable specification section. Provide a table of content showing submittals and their applicable specification section. Ensure PDF documents have clear legible titles based on the content of the submittal. Items of similar nature may be grouped in a single PDF if that PDF includes a clearly labeled table of contents and each Page is clearly identified according to the item. Otherwise, provide individual PDFs for each item of a submittal. Provide one (1) copy of the Submittal after the approval of the electronic version through eBuilder Submittal Process.

C. Product Data (required submittal data)

1. Bill of Materials, including a description of any differences between the specified and the proposed equipment.
2. Manufacturer's product literature, model specifications and performance data, sufficient to verify compliance to specification requirements.
3. Manufacturer's published warranty documents.
4. Include data indicating dimensions, finishes, accessories, hardware, ampacity, rating and listing.
5. Installation instructions as applicable.
6. If the contractor wishes to furnish materials other than those indicated in the contract document, then contractor is solely responsible for providing a written request with clear proof showing how substitute meets and/or exceeds the design intent and contract requirements.

D. Shop Drawings (required submittal data)

1. Show fabrication and installation details, including plans, elevations, and sections of components and attachments to other construction elements. One-line diagrams and wiring diagrams for assembly, and components, interconnection wiring diagrams.
2. When requested by individual Sections provide shop drawings, which include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and the like. Refer to individual Specification Sections for additional requirements for the shop drawings.

E. O&M Manuals (required submittal data)

1. Provide product cut sheet, installation instructions, operating/programming instructions, a parts list with local suppliers, shop drawings, one-lines, diagrams, warranties, and a local repair/maintenance provider. Provide all required submittal data in PDF "e-book" format.
2. Provide copies of certificates of code authority acceptance, test data, product data, guarantees, warranties, and the like.
3. Provide one (1) copy of the O&M manual after the approval of the electronic version through eBuilder Closeout Process.

F. Coordination Drawings (required submittal data)

1. Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around equipment. Show equipment layout and relationships between electrical components and adjacent structural, mechanical, and/or architectural elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

G. Warranties (required submittal data)

1. Provide warranties for all materials and equipment as available by the manufacturer or required by these contract documents.

H. Samples (required submittal data)

1. Submit samples for finish, color, and texture as available for each submittal item.

I. Seismic Qualifications (required submittal data)

1. Provide Seismic Qualification Certificates for equipment requiring seismic restraint either by manufacturer, AHJ, code, contract documents, or owner.
2. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
4. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

J. Closeout Documentation (required submittal data)

1. Submit electrical code authority certification of inspection. Include documentation of on-site electrical testing that was performed.
2. Close out costs: Include separate line items under Contractor and principal subcontracts for Project closeout in an amount totaling five percent (5%) of the contract sum and subcontract amounts.

K. Record Drawings (required submittal data)

1. Show changes and deviations from the Drawings. Include written Addendum and change order items.
2. Show exact routes of feeders 60 amp and larger, conduits for signal systems 2 inches in diameter and larger, and service entrance conduits.
3. Show exact location of switchboards, distribution panelboards, safety disconnects, motor controllers, and the like.
4. Make changes to Drawings in a neat, clean, and legible manner.

5. Provide an 11 x 17 size Record Drawing of the one-line power diagram sealed in a plastic coating. Mount on the wall of the electric room.

#### 1.03 QUALITY ASSURANCE

- A. Conform to requirements of the NEC, latest adopted version with amendments by local AHJs (Oregon Specialty Code).
- B. Conform to latest adopted version of the IBC with Oregon amendments.
- C. Furnish products listed by UL or other testing firm acceptable to AHJ.
- D. Ensure components and/or systems are listed and labeled by a nationally recognized testing laboratory (NRTL) including but not limited to (UL, ETL, CSA, or FM), labeled and/or listed as part of a UL-labeled assembly, or evaluated by a third party acceptable to the authority having jurisdiction (AHJ) as suitable for the use intended. Ensure all labels are applied at the manufacture's factory or facility prior to shipment.
- E. Ensure equipment meets applicable codes and requirements. Where conflicting requirements occur between other required codes or standards, the more stringent requirements apply.
- F. Conform to the requirements of the serving electric, telephone, cable, and/or other utility.
- G. Ensure installer has a minimum of 5 years of experience in performing the work they are engaged in, can provide clear examples and supporting documents to validate their experience to the satisfaction of the owner if requested.
- H. Contractor is required to obtain and pay for electrical permits, plan review, and inspections from local AHJs.
- I. For the proper execution of the work cooperate with other trades, facility staff, contractors, and owner's representative.
- J. To avoid installation conflicts, thoroughly examine the complete set of Contract Documents. Resolve conflicts with Architect prior to installation.
- K. Prior to installation of feeders to equipment requiring electrical connections, examine the manufacturer's shop drawings, wiring diagrams, product data, and installation instructions. Verify that the electrical characteristics detailed in the Contract Documents are consistent with the electrical characteristics of the actual equipment being installed. When inconsistencies occur request clarification from Architect.

#### 1.04 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. Contractor is solely responsible for delivery, storage, and handling which includes but is not limited to storage space, delivery access, equipment for loading/unloading, physical protection, protection from weather, and/or damages.

- B. Handle material/equipment in accordance with manufacturer's written instructions. Lift only by lifting lugs or devices provided for the purpose. Handle carefully to avoid damage to internal components, enclosure, and finish. Contractor is solely responsible for damages, ensure necessary precautions and measures are taken to ensure no damages.
- C. Ensure material/equipment is properly packed and weather-protected to avoid damage or breakage during transport, rough handling, storage, etc.
- D. Contractor is responsible for the makeup of each shipping section including the length, height, weight, etc.
- E. Before accepting any equipment or material, thoroughly inspect shipment before acceptance. Any damage to equipment due to shipping is the contractor's responsibility.

1.05 WARRANTY

- A. Ensure all equipment is warranted free of defects in materials and workmanship.
- B. Manufacturer's warranty is in addition to, not a limitation of, other rights the Owner may have under contract documents.
- C. As a condition precedent to the final payment, execute a written guarantee (warranty) to the owner certifying all contract requirements have been met according to the contract. Written guarantee is to ensure all materials and equipment furnished under this contract are to remain in satisfactory operating condition (normal wear/tear and owner abuse excluded) for one (1) year from the date the Contractor received written notification of final acceptance from the owner.

1.06 CODES AND STANDARDS

- A. NEC: National Electrical Code with Local Amendments, Latest edition
- B. NFPA: National Fire Protection Association
- C. ANSI: American National Standards Institute
- D. SFM: State and Local Fire Marshal
- E. IEEE: Institute of Electrical and Electronics Engineers
- F. NEMA: National Electrical Manufacturers Association
- G. UL: Underwriters' Laboratories, Inc. or equivalent testing lab
- H. Local and State Building Code, Latest edition with Amendments
- I. IES: Illuminating Engineering Society
- J. LPI: Lightning Protection Institute
- K. iNETA: International Electrical Testing Association (ATS and MTS)

1.07 DEFINITIONS

- A. ADA: Americans With Disabilities Act
- B. AFD: Adjustable Frequency Drive
- C. AHJ: Authority Having Jurisdiction
- D. ANSI: American National Standards Institute
- E. APWA: American Public Works Association
- F. ASD: Adjustable Speed Drive
- G. ASTM: American Society for Testing and Materials
- H. BAS: Building automation system.
- I. Contract Documents: Drawings, Specifications, supplemental instructions, addendums and other written documents that define the roles, responsibilities, and "Work" under the construction Contract, and are legally-binding on the parties (Owner and Contractor)
- J. CPT: Control power transformer.
- K. DVD: Digital Video Disc, Electronic storage
- L. EMI: Electromagnetic interference.
- M. EMT: Electrical metallic tubing.
- N. Engineer of Record: A Professional Engineer Registered in the State where the project is located who undertakes final design of the fire protection system.
- O. FCC: Federal Communications Commission
- P. FM: Factory Mutual
- Q. Furnish: To supply the stated equipment or materials.
- R. HVAC: Heating Ventilation and Air Conditioning
- S. IBC: International Building Code
- T. IEEE: Institute of Electrical and Electronics Engineers
- U. IEC: International Electrotechnical Commission
- V. IETA: International Electrical Testing Association
- W. IFC: International Fire Code
- X. IMC: Intermediate metal conduit.

- Y. Install: To set in position and connect or adjust for use. Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at the project site as required to complete items of work furnished by others.
- Z. LAN: Local area network.
- AA. LED: Light-emitting diode.
- BB. MCP: Motor-circuit protector.
- CC. N.C.: Normally closed.
- DD. NEC: National Electrical Code
- EE. NEMA: National Electrical Manufacturer's Association
- FF. NFPA: National Fire Protection Association
- GG. N.O.: Normally open.
- HH. Owner: Building/facility owner, landlord/lessor, tenant/lessee, Insurance Carrier or any designated representative of these entities.
- II. OCPD: Overcurrent protective device.
- JJ. OSHA: Occupational Safety and Health Administration.
- KK. OSSC: Oregon Structural Specialty Code
- LL. Provide: Furnish and Install equipment or materials
- MM. Public Authorities: Local, State or Federal government body having jurisdiction over any portion of the project. This includes, but is not limited to: building departments, Fire Departments, Fire Marshals Offices, Aviation Authorities, Insurance Regulatory Boards, etc.
- NN. PDF: Portable Document Format
- OO. PWM: Pulse-width modulated.
- PP. RFI: Radio-frequency interference.
- QQ. RMC: Rigid metal conduit.
- RR. Seismic Restraint: A structural support element such as a metal framing member, a cable, an anchor bolt or stud, a fastening device, or an assembly of these items used to transmit seismic forces from an item of equipment or system to building structure and to limit movement of item during a seismic event.
- SS. UL: Underwriters' Laboratories, Inc.
- TT. VFD: Variable Frequency Drive

2.01 MANUFACTURERS

- A. Provide equipment and materials from reputable manufacturers with qualified and proven experience in manufacturing the material specified within individual specification sections and/or shown on drawings. Ensure manufacturers have more than 10 years of experience and a proven reputable track record manufacturing the materials, unless otherwise noted. Owner reserves the right to reject any equipment they deem to be of poor quality or ill-suited for the application intended.
- B. Provide like items from one manufacturer; such as, luminaire types, switches, receptacles, breakers, panels, and the like.

2.02 MATERIALS

- A. Provide new materials of the best quality. Ensure materials are manufactured in accordance with NEMA, ANSI, U.L. or other applicable standards.
- B. Any reference to a specific brand, catalog number or other is for the purpose of establishing a minimum level of quality and function. Provide materials that meet and/or exceed that level of quality and/or function and meet the intent of the contract.
- C. Provide material and equipment that is acceptable to AHJ as suitable for the use indicated. For example, provide wet labeled equipment in locations that are wet.
- D. Include special features, finishes, accessories, and other requirements as described in the Contract Documents regardless of the item's listed catalog number.
- E. Provide incidentals not specifically listed in contract documents but which are needed to complete and ensure a safe and satisfactory working system and/or systems.
- F. Provide listed fire stopping or fire rated pass-through for all penetrations through rated barriers whether shown on drawings or not.

3 EXECUTION

3.01 PREPERATION

- A. Coordinate activities with other trades to ensure complete and cohesive installation.
- B. Prepare equipment, material and/or work area in accordance with manufacturer's recommendations.
- C. Examine equipment, material and/or work area for compliance with installation tolerances, shop drawings, manufacturer's recommendations, working clearances, hazards, and/or other conditions affecting performance and installation.

3.02 INSTALLATION



- A. Install electrical equipment complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of the electrical equipment, examine the instructions thoroughly. When requirements of the installation instructions conflict with the Contract Documents, request clarification from Architect prior to proceeding with the installation.
- B. Do not install electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block the area passage's intended usage. Coordinate final location with owner prior to installation.
- C. General
  - 1. Provide an electrically complete and fully functional system for each item, material and/or equipment within the contract documents either exclusively shown in the electrical documents or other division.
  - 2. Ensure installations are in accordance with the equipment manufacturer's instructions, the best industry practices and the Contract Documents. Where a conflict arises, notify the Engineer/Owner for clarification before Work is roughed in, Owner's decision will be final. Work installed without such clarification may require removal and corrected by the Contractor at no cost to the Owner.
  - 3. Ensure installations are performed in a neat, finished and safe manner, according to the latest published NECA Standard of Installation and under competent supervision.
  - 4. Ensure installations comply with the latest local codes.
- D. Noise Control
  - 1. Ensure outlet boxes on opposite sides of partitions are not installed back-to-back. Straight through boxes are not permitted, except where specifically indicated on the Drawings. If straight through boxes are indicated, then ensure appropriate barrier(s) are installed to reduce noise transmission and limit air passage.
  - 2. Ensure contactors, transformers, starters and similar noise producing devices are not installed on walls that are common to occupied spaces unless specifically called for on the Drawings. Where such devices must be mounted on walls, common to occupied spaces, ensure shock absorbers, isolators, or other noise reduction measures are employed to effectively prevent the transmission of their inherent noise to the occupied space.
  - 3. Ballasts, contactors, starters, transformers and/or similar equipment which are found to be noticeably noisier than other equipment on the project will be deemed defective and contractor will be required to replace at no expense to the owner.
- E. Equipment Connections
  - 1. Provide complete electrical connections for equipment requiring such connections, including but not limited to incidental wiring, plugs, materials, devices and labor necessary for a finished working installation.

2. Verify the location and method for connecting equipment prior to roughing-in. Check the voltage and phase of each item of equipment before connecting.
3. Make motor connections for the proper direction of rotation. Provide ¾-inch minimum size flex for mechanical equipment. For exposed motor wiring provide jacketed metallic flex with 6-inches minimum slack loop. Do not run pump motors until liquid is in the system.
4. Control devices and wiring relating to the HVAC systems is furnished and installed under the associated division of work. Electrical contractor to provide pathway, junction boxes, and hardware necessary for HVAC control wiring routing and control device mounting as indicated implicitly or explicitly by the contract documents. Electrical contractor is required to review work by other divisions and coordinate required work with those divisions.
5. Devices and wiring relating to the low voltage systems is furnished and installed under the associated division of work. Electrical contractor to provide pathway, junction boxes, and hardware necessary for low voltage wiring routing and device mounting as indicated implicitly or explicitly by the contract documents. Electrical contractor is required to review work by other divisions and coordinate required work with those divisions.
6. Provide all code required disconnects under this Work, whether specifically shown or not.

F. Equipment Support

1. The Contractor is responsible to determine the means and methods of equipment installation and support. Ensure shop drawings showing seismic restraints for equipment bears the seal and signature of a structural Engineer registered in the state where the Work is being performed. Submit shop drawings to the Architect prior to fabrication. Calculations are to be included for all connections to the structure, considering localized effects.
2. Ensure anchoring and bracing to the building structural elements is in accordance with all codes and regulations regarding seismic and design conditions.
3. Ensure each fastening device and support for equipment, fixture, panel, outlet and/or cabinet is capable of supporting not less than four times the ultimate weight of the object or objects fastened or suspended from the building structure.
4. Properly and adequately support fixtures installed under this Work from the building structure. Ensure supports are provided with proper alignment and leveling of fixtures. Ensure flexible connections where permitted to exposed fixtures are neat and straight, without excess slack, attached to the support device.

5. Support all junction boxes, pull boxes or other conduit terminating housings located above the suspended ceiling from the floor above, roof or penthouse floor structure to prevent sagging or swaying.
6. Conduits:
  - a. Support suspended conduits 1-inch and larger from the overhead structural system with metal ring or trapeze hangers with threaded steel rod having a safety factor of 4. Conduits 3/4-inch installed in ceiling cavities, may be supported on the ceiling system support wires using spring steel clips with not more than one conduit supported per support wire and not to exceed the total structural support limit of the support wire system as dictated by the structural engineer.
  - b. Ensure conduit installed in poured concrete is anchored to the reinforcing steel with No. 14 black iron wire.

G. Alignment

1. Install panels, cabinets and equipment level and plumb, parallel with structural building lines. Ensure switchgear panels and all electrical enclosures fit neatly without gaps, openings or distortion. Properly and neatly close all unused openings with approved devices.
2. Fit surface panels, devices and outlets with neat, appropriate trims, plates or covers, without over-hanging edges, protruding corners or raw edges, to leave a finished appearance.

H. Cutting and Patching

1. Include cutting, patching and restoration of finishes necessary for this Work. Ensure surfaces damaged by this Work and spaces around conduits passing through floors and walls are neatly patched and finished to match the adjacent construction, including painting or other finishes. Clean up and remove all dirt and debris. Ensure the work is performed to the satisfaction of the Owner's Authorized Representative.

I. Firestopping

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate their through penetrating items. Ensure all voids between sleeve or core-drilled hole and pipe passing through are firestopped with approved compound.
2. Foam sealant for use around conduit penetrations to prevent passage of smoke, fire, toxic gas or water. Maintain seal before, during and after fire. In and around conduit for thermal break at penetration of barrier between heated and unheated spaces. Chase Technology Corporation, Fire Foam, Thomas & Betts, or approved.
3. Coordinate with the Drawings the location of fire rated walls, ceilings, floors and the like. When these assemblies are penetrated by electrical equipment, seal around the equipment with approved firestopping material. Maintain integrity of rated assemblies

4. Install firestopping material complete as directed the manufacturer's installation instructions.

J. Conduits

1. Provide pull tape or pull string with preprinted foot markers, secured at each end of unused conduits.
2. Cap unused conduits.

K. Cleaning

1. Remove dirt, dust, and debris from equipment.
2. Ensure entire electrical system installed under this contract is clean, dust-free and in proper working order.
3. Vacuum interiors of electrical equipment enclosures clean.

3.03 TESTS

- A. Conduct tests of equipment and systems to demonstrate compliance with requirements. Refer to individual Specification Sections for required tests. Document tests and include in Closeout Documents.
- B. During site evaluations, by Owner or Engineer, provide an electrician with tools to remove and replace trims, covers, devices, and the like, so that a proper evaluation of the installation can be performed.

3.04 CONTINUITY OF SERVICE

- A. No interruption of services to any part of existing facilities will be permitted without express permission in each instance from the Owner. Obtain written permission from the Owner for any interruption of power, lighting, signal circuit, telecommunications, and/or other system. Coordinate outages with District and power company a minimum of seven calendar days in advance.
- B. Confirm outage times with Owner Representative a minimum of 48 hours in advance.
- C. Owner has indicated that any interruption in operation will incur a cost per hour to be paid by contractor. Coordinate cost per hour with owner for interruption prior to performing any work.
- D. Organize work to minimize duration of service interruption. Provide clear written and documented work plan detailing work during interruption. Ensure owner agrees to work plan before interruption.
- E. The contractor is responsible for ensuring continuity of existing service and will provide over-time, shift and/or other labor means at no additional cost to the owner to ensure that continuity of service.

3.05 DEMOLITION

- A. Remove equipment not scheduled to be reused or relocated from the job site, unless otherwise directed by Owner.

END OF SECTION

1 GENERAL

1.01 REQUIREMENTS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Provide wires, cables, connectors and other components required for a complete and code compliant installation that meets and/or exceeds the requirements of the contract documents.
- C. Coordinate, receive, mount, connect, and place into operation all equipment unless otherwise noted. Provide all conduit, wire, connectors, hardware, and other incidental items necessary for properly system as described herein and shown on the plans. Maintain performance criteria stated by manufacturer without defects, damage, or failure. Comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- D. Consult manufacturer for best practices including but not limited to location, quantity, configuration, and installation.
- E. Ensure conductors for special systems are as recommended by the equipment manufacturer except where specifically noted otherwise.

1.02 SUBMITTALS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Provide required information for conductors, connectors, and lugs/pads.
- C. Provide the insulation cable testing report in the project closeout documentation.

1.03 QUALITY ASSURANCE

- A. Meet all requirements as specified in section 260500.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Deliver conductors to the job site in cartons, protective covers or on reels.

1.05 WARRANTY

- A. As specified in Specification section 260500, sub-section 1.5 or as noted below.

2 MATERIALS

2.01 MANUFACTURERS

- A. Meet all requirements as specified in section 260500 and as noted below.

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B. Southwire, Hatfield, Anaconda, Rome, or approved equal.

2.02 MATERIALS

A. Meet all requirements as specified in section 260500 and as noted below.

B. Conductors – 600V:

1. No. 12 AWG minimum size unless noted otherwise or required due to voltage drop.
2. Provide soft drawn Class B stranded for wire No. 12 and larger.
3. Stranded: Copper, concentric or compressed.
4. Design is based on use of copper conductors.
5. Insulation: THHN, THWN, XHHW unless noted or specified otherwise by code.
6. Phase color to be consistent at all feeder terminations; A B C, top to bottom, left to right, front to back.

7. Color Code Conductors as Follows:

PHASE	208V WYE	480 VOLT
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green
Isolated Ground	Green w/yellow trace	N/A

8. Conductors minimum insulation rating of 90C.
9. Insulation types THWN, THHN or XHHW. Minimum insulation rating of 90C for branch circuits.
10. Ensure through wiring in lighting fixtures is rated for 90-degree C.

C. Connectors:

1. Quick push-in wire connectors are prohibited. No. 18 to 8awg, spring connector wire nuts.

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES  
SECTION 26 0519-3

2. Branch Circuit Conductor Splices: Live spring type, Wing Nut or self-stripping type.
3. Cable Splices: Compression tool applied sleeves with 600V heat shrink insulation.
4. Copper Pads: Drilled and tapped for multiple conductor terminals.
5. Lugs: Indent/compression type for use with stranded branch circuit or control conductors.
6. Solid Conductor Branch Circuits: Spring connectors, wire nuts, for conductors 18 through 8AWG.

D. Lugs and Pads:

1. Ampacity: Cross-sectional area of pad for multiple conductor terminations to match ampere rating of panelboard bus or equipment line terminals.

3 EXECUTION

3.01 PREPERATION

- A. Meet all requirements as specified in section 260500.

3.02 INSTALLATION

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Shared neutrals are not permitted, provide separate neutrals.
- C. Conductors:
1. Pulling compounds may be used with the residue cleaned from the conductors and raceway entrances after the pull is made.
  2. Provide pulleys or blocks for alignment of the conductors when pulling. Ensure pulling is in accordance with manufacturer's Specifications regarding pulling tensions, bending radii of the cable and compounds.
  3. Provide copper conductors for entering terminal or junction boxes mounted on hermetically sealed refrigeration compressor motors.
  4. Make up and insulate wiring promptly after installation of conductors. Do not pull wire until all bushings are installed and raceways terminations are completed. Do not pull wire into conduit embedded in concrete until after the concrete is poured and forms are stripped.
  5. Conductor sizes shown on the Drawings are for copper only.
  6. Remove insulation with a stripping tool specifically designed for that purpose. Leave all conductors nick free.



LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES  
SECTION 26 0519-4

7. Install conductors in raceways having adequate, code size cross-sectional area for wires indicated.
8. Install conductors with care to avoid damage to insulation.
9. Do not apply greater tension on conductors than recommended by manufacturer during installation.
10. Provide all required conductors for a fully operable system.
11. Install VFD conductor between VFD and motor.

D. Connectors:

1. Ensure control and special systems wires are terminated with a tool applied spade flared lug when terminating at a screw connection.
2. Ensure all screw and bolt type connectors are made up tight and retightened after an eight-hour period.
3. Ensure all tool applied compression connectors are applied per manufacturer's recommendations and physically checked for tightness.

E. Color Coding:

1. Phase color code to be consistent at all feeder terminations, A-B-C left-to-right or A-B-C top-to-bottom.
2. Switchlegs, travelers, etc. to be consistent with the phases to which connected or a color distinctive from that listed.

F. Splices:

1. Unless otherwise noted in drawings or approved by Engineer, all conductors shall be installed in continuous runs without splices.
2. Splices are to be made up complete promptly after wire installation. Provide single wire pigtails for fixture and device connections. Wire nuts may be used for fixture wire connections to single wire circuit conductor pigtails.
3. Ensure splices utilize wing nut connectors installed properly. Splices and terminations for No.8 and larger wires may be made with approved pressure-type connectors. Ensure taped joints are applied in half lap layers with stretching to deformations.
4. Ensure emergency system feeders and circuits are not spliced.

3.03 TESTS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Provide megohmmeter test on conductor insulation for conductors rated 100 amp and greater. Follow Insulated Cable Engineers Association testing procedures

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES  
SECTION 26 0519-5

for cables 600V or less. Consult conductor manufacturer for acceptable insulation test values, if conductors fail test then replace and retest.

- C. Prepare a typed tabular report indicating the testing instrument, the feeder tested, amperage rating of the feeder, insulation type, voltage, the approximate length of the feeder, conduit type, and the measured resistance of the megohmmeter test. Submit report with operating and maintenance manual.

END OF SECTION

1 GENERAL

1.01 REQUIREMENTS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Provide grounding and bonding system required for a complete and code compliant installation that meets and/or exceeds the requirements of the contract documents.
- C. Use hydraulic compression tool applied connectors where possible, or exothermic welding process connectors.
- D. Coordinate, receive, mount, connect, and place into operation all equipment unless otherwise noted. Provide all conduit, wire, connectors, hardware, and other incidental items necessary for properly system as described herein and shown on the plans. Maintain performance criteria stated by manufacturer without defects, damage, or failure. Comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- E. Consult manufacturer for best practices including but not limited to location, quantity, configuration, and installation.
- F. Ensure the grounding electrode system is composed of interconnected buried or concrete-embedded grounding electrode conductors, ground rod, ground ring, telecommunications grounding, structure ground, and pipe ground.
- G. Bond the electrical service system neutral at service entrance equipment to the grounding electrodes (do not use piping).
- H. Bond each separately derived system neutral to specific purpose grounding grid plate at the nearest column electrode or grounding grid pigtail.
- I. Bond together enclosures, exposed concurrent carrying metal parts of electrical equipment, metal raceway systems, bonding conductor in raceways and cables, receptacle grounding connectors, and plumbing systems.

1.02 SUBMITTALS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Provide grounding system test reports.

1.03 QUALITY ASSURANCE

- A. Meet all requirements as specified in section 260500.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Meet all requirements as specified in section 260500.

1.05 WARRANTY

- A. Meet all requirements as specified in section 260500.

2 MATERIALS

2.01 MANUFACTURERS

- A. Wire: As specified in Specification section 260519 or as noted below.
- B. Connectors: Harger, Galvan Electrical, GME, or equal.
- C. Electrodes: Harger, Galvan Electrical, GME, or equal.
- D. Grounding connectors: Burndy Hyground Compression System, Erico/Cadweld, Amp Ampact Grounding System or approved.
- E. Pipe grounding clamp: Burndy GAR Series, O Z Gedney, Thomas & Betts or approved.

2.02 MATERIALS

- A. Bonding Conductors: Bare or green insulated copper, minimum size 4AWG.
- B. Grounding Electrode Conductor: Bare copper stranded conductor.
- C. Grounding Connectors: Exothermic welding process connectors or powder actuated compression tool applied connectors. Mechanical type of connectors is not acceptable.

3 EXECUTION

3.01 PREPERATION

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Clean all grounding surfaces and connections.

3.02 INSTALLATION

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Use of conduit as primary ground path is not acceptable.
- C. Provide an exothermic weld for ground grid, building steel, and ground electrodes.
- D. Installation of Grounding and Bonding System:
  - 1. Ensure grounding and bonding conductors are sized in accordance with the National Electrical Code.

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2. Ensure bonding conductor connectors are made up tight, located for future servicing and are low impedance (5-ohm max as a system).
3. Ensure feeder and service raceways are bonded to the grounding electrode system.
4. Ensure plug-in receptacles are bonded to the boxes, raceways and bonding conductor.
5. Provide equipment bonding conductor in all conduit runs and bond to conduit using compression fitting.
6. Provide insulated bonding conductor in all branch circuits.
7. Air-Duct Equipment Circuits: Install insulated equipment bonding conductor to duct-mounted electrical devices operating at 120 V and more, including heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
8. Signal and Communication Equipment: For telephone, access control, BMCS, fire alarm and annunciation, voice and data, and other communication equipment, provide insulated bonding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
  - a. Service and Central Equipment Locations and Wiring Closets: Terminate bonding conductor on a grounding bus.
  - b. Terminal Cabinets: Terminate bonding conductor on cabinet grounding terminal.
9. Raceways:
  - a. Ground all metallic raceway systems. Bond to ground terminal with code size jumper except where code size or larger grounding conductor is included with circuit, use grounding bushing with lay-in lug.
  - b. Connect all metal raceways, which terminate within an enclosure but without mechanical connection to the enclosure, by grounding bushings and ground wire to the grounding bus.
  - c. Where equipment supply conductors are in flexible metallic conduit, install stranded copper equipment grounding conductor from outlet box to equipment frame.
  - d. Install equipment grounding conductor, code size minimum unless noted on Drawings, in all nonmetallic raceway systems.
10. Feeders and Branch Conduits:
  - a. Install continuous insulated equipment copper ground conductors within the following circuits; feeders, circuits for computer systems and other circuits as indicated on Drawings.

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- b. Where installed in a continuous solid metallic raceway system and larger sizes are not detailed, provide insulated equipment ground conductors for feeders and branch circuits sized in accordance with NEC.
- 11. Boxes, Cabinets, Enclosures and Panelboards:
  - a. Install bonding lugs and bond enclosure with grounding conductor.
  - b. Bond all sections of service equipment enclosure to service ground bus.
- 12. Motors, Equipment and Appliances: Install code size equipment grounding conductor from outlet box to (motor) equipment frame or manufacturer's designated ground terminal.
- 13. Receptacles: Connect ground terminal of receptacle to equipment ground system and to outlet box except isolated grounds where noted. Self-grounding nature of receptacle devices does not eliminate the requirement for ground conductor bolted to outlet box and grounding system.
- 14. Telecommunications Backboard: Provide telecommunications ground bar at each telecommunications backboard. Bond the grounding bar to service grounding bar in the main service equipment.
- 15. Separately Derived Systems: Ground each separately derived system per NEC.

3.03 TESTS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. After installation of grounding system provide a "Fall of potential" or "3-point" test for ground system. "Induced Frequency" or "Clamp-on" test may not be used unless contractor can clearly and unequivocally demonstrate how they intend on administering the test and provide written verification of the results. Report test results in a tabulated spreadsheet with time/date and indicating test location, indicate ground wire size and test value. Provide floor plan as necessary to clearly indicate test point. Ensure system impedance is 5 ohms or less, provide corrective action for any points that fails.
- C. Provide an "Earth Loop" impedance test for all major ground connections including but not limited to main service gear, distribution panels, branch panels, equipment with grounds larger than #10 AWG, and telecommunications ground bars. Report test results in a tabulated spreadsheet with time/date and indicating test location by equipment and column, indicate ground wire size and test value. Provide floor plan as necessary to clearly indicate test point. Provide corrective action for any points that fail.

END OF SECTION

1 GENERAL

1.01 REQUIREMENTS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Provide hangers and supports required for a complete and code compliant installation that meets and/or exceeds the requirements of the contract documents.
- C. Coordinate, receive, mount, connect, and place into operation all equipment unless otherwise noted. Provide all conduit, wire, connectors, hardware, and other incidental items necessary for properly system as described herein and shown on the plans. Maintain performance criteria stated by manufacturer without defects, damage, or failure. Comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- D. Consult manufacturer for best practices including but not limited to location, quantity, configuration, and installation.
- E. Ensure items to be supported include raceways, cables, wireways, cable trays, busways, boxes, cabinets, equipment, and other electrical products, systems and raceways. Where support materials or workmanship is unique to a particular product, specify unique features that are the exception to these default requirements in the Section that specifies the product. Coordinate specifications for supporting devices with structural engineer and with Drawings.
- F. Ensure supports for multiple raceways, including but not limited to comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- G. Ensure supports for raceways are capable of supporting combined weight of supported systems and its contents.
- H. Ensure equipment supports are capable of supporting combined operating weight of supported equipment and connected systems and components.
- I. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed, with a minimum structural safety factor of five times the applied force.

1.02 SUBMITTALS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Provide seismic and load calculations for each piece of equipment requiring anchorage.
- C. Provide seismic and load calculations for supports, raceways, and similar.
- D. Provide shop drawings showing type and method of anchorage for equipment, supports, raceways, and similar.

1.03 QUALITY ASSURANCE

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Qualify procedures and personnel according to Structural Welding Code.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Meet all requirements as specified in section 260500.

1.05 WARRANTY

- A. Meet all requirements as specified in section 260500.

2 MATERIALS

2.01 MANUFACTURERS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Hangers: Kindorf B 905 2A channel, H 119 D washer, C105 strap, 3/8-inch rod with ceiling flange.
- C. Concrete Inserts: Kindorf D 255, cast in concrete for support fasteners for loads up to 800 lbs.
- D. Pipe Straps: Two-hole galvanized or malleable iron.
- E. Luminaire Chain: Campbell Chain 75031, 90 lb. test with steel hooks.
- F. B-line, Allied Tube & Conduit, Cooper B-Line, Inc.; a division of Cooper Industries, ERICO International Corporation, GS Metals Corp, Thomas & Betts Corporation, Unistrut; Tyco International, Ltd, or approved equal.

2.02 MATERIALS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Steel Slotted Support Systems:
  - 1. Metallic Coatings: Hot-dip galvanized after fabrication.
  - 2. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester.
  - 3. Painted Coatings: Manufacturer's standard painted coating.
  - 4. Channel Dimensions: Selected for applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.



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- E. Structural Steel for Fabricated Supports and Restraints: Steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, or steel, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Hilti Inc., ITW Ramset/Red Head; a division of Illinois Tool Works, Inc., MKT Fastening, LLC., and Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
  - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Cooper B-Line, Inc.; a division of Cooper Industries, Powers Fasteners, Inc., Hilti Inc., ITW Ramset; a division of Illinois Tool Works, Inc., MKT Fastening, LLC., and Simpson Strong-Tie Co., Inc.
  - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units.
  - 4. Clamps for Attachment to Steel Structural Elements: type suitable for attached structural element.
  - 5. Through Bolts: Structural type, hex head, and high strength.
  - 6. Toggle Bolts: All-steel springhead type.
  - 7. Hanger Rods: Threaded steel.
  - 8. Lag Screws: Threaded fastener for use with wood framing, with tension, shear and pullout capacities appropriate for supported loads, and spacing and edge distances appropriate to prevent splitting where used
- G. FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES
  - 1. Equipment supports in this Article require calculation of load and strength for each component and detailing of each assembly. Coordinate specifications for each equipment support with structural engineer and with Drawings.
  - 2. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

3 EXECUTION

3.01 PREPERATION

- A. Meet all requirements as specified in section 260500 and as noted below.

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- B. Coordinate support and anchorage activities with other trades to ensure only calculated loads will be present on supports or anchors.
- C. Verify mounting height of all luminaires, equipment, or supports.

3.02 INSTALLATION

- A. Meet all requirements as specified in section 260500 and as noted below.

- B. GENERAL

1. Provide support for all electrical equipment.
2. Provide independent supports to structural member for electrical luminaires, materials, or equipment installed in or on ceiling, walls or in void spaces or over furred or suspended ceilings.
3. Do not use other trade's fastening devices as supporting means for electrical equipment materials or fixtures.
4. Do not use supports or fastening devices to support other than one particular item.
5. Support conduits within 18 inches of outlets, boxes, panels, cabinets and deflections.
6. Maximum distance between supports not to exceed 8 foot spacing or code maximum.
7. Securely suspend all junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from the floor above or roof structure to prevent sagging and swaying.
8. Provide seismic bracing per UBC requirements.
9. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by code. Ensure minimum rod size is 1/4 inch in diameter.
10. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
11. Secure raceways and cables to these supports with two-bolt conduit clamps, single-bolt conduit clamps OR single-bolt conduit clamps using spring friction action for retention in support channel.
12. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

- C. INSTALLATION OF SUPPORTS

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1. Ensure wall mounted panelboards, switches, and/or other electrical systems are not supported on the metal insulated panel. Provide steel frames as needed to support these items from the building structural elements.
2. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Ensure minimum static design load used for strength determination is weight of supported components plus 200 lb.
3. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - a. To New Concrete: Bolt to concrete inserts.
  - b. To New or Existing Concrete: Mechanical-expansion anchor fasteners.
  - c. To Steel: Beam clamps or Spring-tension clamps.
  - d. To Light Steel: Sheet metal screws.
  - e. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panel boards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
4. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

D. INSTALLATION OF FABRICATED METAL SUPPORTS

1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

E. INSTALLATION OF CONCRETE BASES

1. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
2. Anchor equipment to concrete base.
  - a. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - b. Install anchor bolts to elevations required for proper attachment to supported equipment.

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- c. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

F. PAINTING

- 1. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- 2. Touchup: Provide cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- 3. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint.

3.03 TESTS

- A. Meet all requirements as specified in section 260500.

END OF SECTION

1 GENERAL

1.01 REQUIREMENTS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Provide raceway and boxes required for a complete and code compliant installation that meets and/or exceeds the requirements of the contract documents.
- C. Ensure all pull boxes, junction boxes, and other enclosures are accessible without conflict from other equipment or trades. Install pull boxes and junction boxes where required to facilitate wire installation.
- D. Coordinate, receive, mount, connect, and place into operation all equipment unless otherwise noted. Provide all conduit, wire, connectors, hardware, and other incidental items necessary for properly system as described herein and shown on the plans. Maintain performance criteria stated by manufacturer without defects, damage, or failure. Comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- E. Consult manufacturer for best practices including but not limited to location, quantity, configuration, and installation.
- F. Provide raceways and conduits of specified types for all electrical systems wiring, except where clearly shown or specified otherwise. Ensure all fitting, boxes, hangers and appurtenances are included.
- G. Size raceways and conduits as indicated on the Drawings. Where no size is indicated, conduit may not be smaller than 3/4" for the quantity of type THHW/THHN conductors installed.

1.02 SUBMITTALS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Provide shop drawings showing coordination with other trades for overlapping areas.
- C. Provide shop drawings showing routing of conduits larger than 1-1/2".
- D. Provide junction box fill calculations for boxes not pre-stamped with wire fill limits and/or custom fabricated boxes.
- E. Provide shop drawings for junction/pull boxes larger than 12" x 12" showing conduits entering and exiting along with conduit next point of connection listed. Identify location of junction/pull boxes on floor plans.

1.03 QUALITY ASSURANCE

- A. Meet all requirements as specified in section 260500.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Meet all requirements as specified in section 260500.

1.05 WARRANTY

- A. Meet all requirements as specified in section 260500.

2 MATERIALS

2.01 MANUFACTURERS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Raceways: Allied Steel, Certainteed, Jones & Laughlin, Carlon, Kraloy, or approved.
- C. Conduit Fittings: O Z Gedney, Thomas & Betts, Crouse & Hinds, or approved.
- D. Surface Metal Raceway System: Square D, Wiremold, or approved, unless specifically noted on Drawings.
- E. Outlet Boxes: Bowers, Raco, or approved.
- F. Junction and Pull Boxes: Circle AW, Hoffman, or approved.
- G. Box Extension Adapter: Bell, Red Dot, Carlon, or approved.
- H. Conduit Fittings: O Z Gedney, Thomas & Betts, or approved.

2.02 MATERIALS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Metallic Conduits:
  - 1. Galvanized Rigid Conduit (GRC): Threaded rigid heavy wall hot-dip galvanized steel.
  - 2. Intermediate Metal Conduit (IMC): Threaded intermediate hot-dip galvanized steel.
  - 3. Electrical Metallic Tubing (EMT): Zinc coated or hot-dip galvanized.
  - 4. Flexible Metal Conduit (FMC): Reduced wall flexible galvanized steel, hot dip galvanized prior to forming and joining.
  - 5. Flexible Metal Conduit (FMC) – PVC Coated: FMC with PVC chemical resistant jacket extruded to core up to 1-inch trade size and tubed over core up to 4-inch trade size.
- C. Non-metallic Conduits:

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1. Polyvinyl Chloride Conduit (PVC): Type II/Schedule 40 heavy wall rigid PVC, rated for use with 90C conductors, and carries U.L. listing for above and below ground use.

D. Surface Metallic Raceways:

1. Single Channel Surface Raceway:
  - a. Power: Provide 20-amp multi-circuit raceway as indicated on Drawings with screw type cover.
  - b. Signal: Blank cover with outlets as indicated on Drawings with snap on cover.
2. Two Channel Surface Raceway: One channel for power, the other channel for signal. Provide divider between channels.
3. Provide lengths scaled from Drawings to a tolerance of 1/2 inch, over raceway length, between end wall surfaces.
4. Provide endcaps, corner joints, tees, transition fittings, and the like, for a complete installation.
5. Verify exact mounting height with Drawings.
6. Finish: Utility spaces provide Gray, other spaces coordinate color selection with wall architect.

E. Wireways:

1. Troughs: Steel, painted, square in cross section, preformed knock-outs on standard spacing, hinged cover. Tees, elbows, couplings as required for configuration shown on the Drawings.
2. Supports: U-shaped, 1/4-inch by 1-1/2-inch steel strap, bent and prime painted.
3. Bonding: Provide bonding accessories for each section according to manufacturer's instructions.

F. Fittings:

1. Bushings:
  - a. Insulated Type for Threaded Rigid and IMC Conduit or Raceway.
  - b. Insulated Grounding Type for Threaded Rigid and IMC.
2. Raceway Connectors and EMT Couplings:
  - a. Steel conductor and coupling bodies, with zinc electroplate or hot dip galvanizing.

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- b. Connector locknuts are steel, with threading meeting ASTM tolerances. Locknuts are zinc electroplated or hot-dip galvanized.
  - c. Connector throats (EMT, flexible conduit, metal clad cable and cordset connectors) have factory installed plastic inserts permanently installed. For normal cable or conductor exiting angles from the raceway (NEC bending radius), the cable jacket or conductor insulation bears only on the plastic throat insert.
- 3. GRC and IMC:
  - a. The conduit itself must be threaded. Use of threaded couplings attached by any means are not allowed.
  - b. Threaded locknuts.
  - c. Threaded bushings: 1-1/4 inch and larger of the insulated, grounding type.
- 4. EMT:
  - a. Connectors: Steel compression ring type for conduit termination, with insulated throat, suitable for conditions used.
  - b. Couplings:
    - 1) Indoor: set screw type.
    - 2) Outdoor: Steel compression ring type, concrete tight.
- 5. Weatherproof Connectors: Threaded pipe connections with waterproofing compound.

G. Outlet boxes

- 1. Flush and Concealed Outlet Boxes: Galvanized stamped steel with screw ears, knock-out plugs, mounting holes, fixture studs if required.
- 2. Surface Outlet Boxes: Galvanized stamped steel same as above for use on ceilings; cast steel or aluminum with threaded hubs for use on walls.
- 3. Large Boxes: Ensure boxes exceeding 4-11/16 inches square are of welded steel construction with screw cover and painted, steel gauge as required by physical size.
- 4. Luminaire Outlet: 4-inch octagonal box, 1 1/2 inches deep with 3/8-inch luminaire stud if required. Provide raised covers on bracket outlets and on ceiling outlets.
- 5. Device Outlet: Installation of one or two devices at common location, minimum 4-inch square, minimum 1 1/2 inches deep. Single or 2 gang flush device raised covers.
- 6. Signal system: minimum 4-inch square, minimum 2 1/8 inches deep.



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7. Multiple Devices: Three or more devices at common location. Install 1-piece gang boxes with 1-piece device cover. Install one device per gang.
8. Construction: Provide galvanized steel interior outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.
9. Accessories: Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.
10. Non-metallic Boxes: PVC, molded enclosures, threaded hubs.
11. Weatherproof: Provide corrosion-resistant cast metal weatherproof outlet wiring boxes, of the type, shape and size, including depth of box, with threaded conduit ends, cast metal face plate with spring-hinged waterproof cap suitably configured for each application, including face plate gasket, blank plugs and corrosion proof fasteners. Weatherproof boxes to be constructed to have smooth sides, gray finish.
12. Box Extension Adapter: Diecast aluminum.
13. Junction and Pull Boxes
  - a. Provide galvanized sheet steel junction and pull boxes, with screw-on covers; of the type shape and size, to suit each respective location and installation; with welded seams and equipped with steel nuts, bolts, screws and washers.
  - b. Install junction boxes above accessible ceilings for drops into walls for receptacle outlets from overhead.
  - c. Install junction boxes and pull boxes as required to facilitate the installation of conductors and limiting the accumulated angular sum of bends between boxes, cabinets and appliances to 270 degrees.

3 EXECUTION

3.01 PREPERATION

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Verify final routing of raceway and box placement.
- C. Verify anchors and supports are installed.
- D. Coordinate location of sleeves and fire rated pass throughs.

3.02 INSTALLATION

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. General:
  - 1. Conceal all conduits in finished spaces and elsewhere so far as practicable. Ensure concealed conduits run in a direct line with long sweep bends and offsets. Ensure GRC and IMC embedded in concrete below grade or in damp locations are made water-tight by painting the entire male thread with Rustoleum metal primer, or equal, before assembly.
  - 2. Route exposed conduit parallel or at right angles to structural building lines, and neatly offset into boxes. Ensure conduits attached directly to building surfaces are closely follow the surfaces. Ensure conduit fittings are used to "saddle" under beams.
  - 3. Ensure conduits, whether exposed or concealed, are securely supported and fastened at intervals of nominally every 6-feet and with 18-inches of each outlet, ell, fitting, panel, etc.
  - 4. Keep conduit and raceways closed with suitable plugs or caps during construction to prevent entrance of dirt, moisture, concrete or foreign objects. Ensure raceways are clean and dry before installation of wire and at the time of acceptance.
  - 5. Pack spaces around conduits with oakum and seal to prevent entrance of moisture where conduits are installed in sleeves or block-outs penetrating moisture barriers.
  - 6. Where conduits penetrate fire rated concrete walls or floors, provide non-combustible caulking or putty fire barrier material of thickness required to equal or exceed the fire rating of wall or floor.
  - 7. Ensure raceway provides an independent path for each system, which includes but is not limited to power, lighting, telecommunications, security, fire alarm, control, low voltage, etc. Do not mix systems in same path.
- C. Conduits:
  - 1. Assemble conduits continuous and secure to boxes, panels, luminaires and equipment with fittings to maintain continuity. Provide watertight joints where embedded in concrete, below grade or in damp locations.
  - 2. Exposed conduits permitted only on existing block walls and in utility type spaces including but not limited to mechanical rooms and electrical rooms or unless noted specifically on drawings as exposed. Install exposed conduits with a clean appearance - parallel and at right angles to building lines, tight to finished surfaces and neatly offset in boxes.
  - 3. Install GRC or IMC galvanized steel conduits for wiring underground, in-cast-concrete construction, in damp locations, in hazardous areas and where subject to mechanical injury, with threaded fittings made up tight.

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4. EMT may be employed in all other dry protected locations.
5. Flex is required where flexibility is necessary as at motors, transformers and recessed lighting fixtures, etc. Ensure flex is of jacketed type, except where concealed in dry locations and spaces such as ceiling cavities. Install 12-inch minimum slack loop on flexible metallic conduit and PVC coated flexible metallic conduit.
6. Schedule 40 PVC may be used underground, under interior slabs or where scheduled or noted on the Drawings. Make connections with waterproof solvent cement. Provide GRC at 60 degree and larger bends and where penetrating slabs or elling up above grade in exterior locations.
7. Below Grade Conduit and Cables: Conduit depth shall be a minimum of 18-inches below grade. Place a minimum 3-inch cover of sand or clean earth fill around the cable or conduit on a leveled trench bottom. Lay conduit on a smooth level trench bottom, so that contact is made for its entire length. Remove water from trench before electrical conduit is installed.
8. Unless otherwise indicated, provide raceway systems for lighting, power and Class 1 remote-control and signaling circuits and Class 2 and 3 remote-control signaling and communication circuits. Use pre-manufactured rigid PVC bends where required.
9. Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block the area passage's intended usage.
10. Do not install conduits on surface of building exterior, across roof, on top of parapet walls, or across floors.
11. Maximum Bends: Install code sized pull boxes to restrict maximum bends in a run of conduit to 270 degrees.
12. Conduit Terminations: Provide conduits shown on Drawings which terminate without box, panel, cabinet or conduit fitting with not less than five full threads. Bushings and metal washer type sealer between bushing and conduit end.
13. Conduit Size: Size as indicated on Drawings. Where size is not indicated, provide conduit in minimum code permitted size for THW conductors of quantity shown. Minimum trade size 3/4 inch.
14. Flexible Conduit: Install 12-inch minimum slack loop on flexible metallic conduit and PVC coated flexible metallic conduit.
15. Install pull wire or nylon cord in empty raceways provided for other systems. Secure wire or cord at each end.
16. Elbows for Signal Cables: Use long radius factory ells where linking sections of raceway for installation of signal cable.

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17. Motors, recessed luminaires and equipment connections subject to movement or vibration, use flexible metallic conduit.
  18. Motors and equipment connections subject to movement or vibration and subjected to any of the following conditions; exterior location, moist or humid atmosphere, water spray, oil or grease use PVC coated liquid tight flexible metallic conduit.
  19. Branch Circuits: Do not change the intent of the branch circuit or controls without approval. Homeruns for 20-amp branch circuits may be combined to a maximum of six conductors in a homerun. Apply derating factors as required by NEC and increase conductor size as needed. Coordinate any derating calculations with facility engineer prior to performing work.
  20. Feeders: Do not combine or change feeder runs.
  21. Unless otherwise indicated, provide raceway systems for lighting, power and Class 1 remote-control and signaling circuits and Class 2 and 3 remote-control signaling and communication circuits.
- D. Raceways:
1. Install per manufacturer's installation instructions, parallel to building lines.
  2. Surface metal raceway with snap-in cover may be used in finished spaces only as specified or shown on Drawings.
  3. Surface metal wireways may be installed at locations to serve motor starters or other control devices where required by a multitude of wiring interconnections or physical layout.
- E. Sleeves and Chases - Floor, Ceiling and Wall Penetrations: Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceiling or walls.
- F. Fittings: Ensure metallic raceways and conduits are assembled continuous and secured to boxes, panels, etc., with appropriate fittings to maintain electrical continuity. Ensure all conduit joints are cut square, reamed smooth with all fittings drawn up tight.
- G. Boxes:
1. Install junction boxes and pull boxes as required to facilitate the installation of conductors and limiting the accumulated angular sum of bends between boxes, cabinets and appliances to 270 degrees.
  2. Box extender: Install over flush wall outlet boxes to permit flexible raceway extension from flush outlet to fixed or movable equipment.
  3. Location: Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.

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4. Round Boxes: Avoid using round boxes where conduit must enter through side of box, which would result in a difficult and insecure connection with a locknut or bushing on the rounded surface.
5. Anchoring: Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.
6. Special Application: Provide weatherproof outlets for locations exposed to weather or moisture.
7. Knockout Closures: Provide knockout closures to cap unused knockout holes where blanks have been removed.
8. Mount Center of Outlet Boxes, unless Otherwise Required by ADA, or Noted on Drawings, the Following Distances above the Floor:
  - a. Control Switches: 48 inches.
  - b. Receptacles: 18 inches.
  - c. Telecom Outlets: 18 inches.
  - d. Other Outlets: As indicated in other Sections of Specifications or as detailed on Drawings.
9. Coordinate all electrical device locations (switches, receptacles, and the like) with Drawings to prevent mounting devices in mirrors, back splashes, behind cabinets, and the like.
10. Provide pull boxes where shown or where required to limit the number of bends in any conduit to not more than three 90-degree bends or equivalent. Use galvanized boxes of code required size with removable covers installed so that covers will be accessible after Work is completed.
11. Ensure boxes are flush with finished surfaces or not more than 1/8-inch below surface and be level and plumb. Long screws with spacers or shims for mounting devices will not be acceptable. Ensure no combustible material is exposed to wiring at outlets.

H. Expansion Joints:

1. Ensure all conduits 3 inches and larger where not cast in concrete are rigidly secured to the building structure on opposite sides of a building expansion joint with an expansion-deflection fitting across the joint, equivalent to Oz/Gedney AXDX, installed per manufacturer's recommendations.
2. Ensure all conduits less than 3 inches where not cast in concrete are provided with junction boxes securely fastened on both sides of the expansion joint, connected together with 15 inches of slack (a minimum of 15 inches longer than the straight-line length) flexible conduit with copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits 3 inches and larger may be installed.

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I. Seismic Joints:

1. Ensure all conduits are provided with junction boxes securely fastened on both sides of the expansion joint, connected together with 15 inches of slack (a minimum of 15 inches longer than the straight lines length) flexible conduit with copper green ground bonding jumper. Prior to installation, verify with Engineer that the 15 inches is adequate for the designed movement, and if not, increase the length as required.

J. Miscellaneous:

1. Ensure conduits piercing a building waterproof membrane are provided with flanges, using two neoprene washers, one washer on each side of membrane, between each flange and membrane. Where architectural drawings indicate a different method, architectural method takes precedence.
2. Ensure raceways are clean and free of debris.
3. Provide a pull string in all empty conduits.

K. Telecommunications Pathway

1. Install pathway for telecommunications systems at minimum 12" from electrical cabling.
2. Comply with BICSI and TIA/EIA recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
3. Ensure pathway is a minimum of 8 inches from lighting fixtures.
4. Conceal raceway behind walls or in ceiling space, use of surface mount is only permitted when agreed to by the owner.
5. Ensure conduit ends, including vertical stubs in wall cavities, are fitted with insulated grommets.
6. Where the use of concealed or surface conduit must be used, provide a minimum box size for the data/voice termination of 4 x 4 x 2 ½ inches, complete with either a single gang or double gang mud ring as required by the number of drops specified.

3.03 TESTS

- A. Meet all requirements as specified in section 260500.

END OF SECTION

1 GENERAL

1.01 REQUIREMENTS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Provide identification required for a complete and code compliant installation that meets and/or exceeds the requirements of the contract documents.
- C. Coordinate, receive, mount, connect, and place into operation all equipment unless otherwise noted. Provide all conduit, wire, connectors, hardware, and other incidental items necessary for properly system as described herein and shown on the plans. Maintain performance criteria stated by manufacturer without defects, damage, or failure. Comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- D. Consult manufacturer for best practices including but not limited to location, quantity, configuration, and installation.
- E. Clearly and properly identify the complete electrical system to indicate the loads served or the function of each item of equipment connected under this Work.
- F. Coordinate names, abbreviations and other designations with equipment specified in this or other Divisions of the Specification or identified on Drawings.

1.02 SUBMITTALS

- A. Meet all requirements as specified in section 260500.

1.03 QUALITY ASSURANCE

- A. Meet all requirements as specified in section 260500.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Meet all requirements as specified in section 260500.

1.05 WARRANTY

- A. Meet all requirements as specified in section 260500.

2 MATERIALS

2.01 MANUFACTURERS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Engraved Labels: Lamicoid or approved.
- C. Conductor Numbers: Brady or approved.
- D. Underground Utilities Ribbon: Allen Systems, Inc., or approved.

2.02 MATERIALS

- A. As specified in Specification section 260500, sub-section 2.1 or as noted below.
- B. Engraved Labels
  - 1. Melamine plastic laminate, black with white core, 1/16 inch thick.
  - 2. Engravers standard letter style, minimum 3/16-inch-high letters, all capitals.
  - 3. Drill or punch labels for mechanical fastening except where adhesive mounting is necessary because of substrate. Use self-tapping stainless-steel screws.
  - 4. Dymo tape labels are not acceptable.
- C. Conductor Numbers
  - 1. Manufacturer's standard vinyl-cloth self-adhesive cable and conductor markers of the wraparound type. Preprinted black numbers on yellow field.
- D. Branch circuit schedules
  - 1. Provide branch circuit identification schedules, typewritten, clearly filled out, to identify load connected to each circuit and location of load. Numbers to correspond to numbers assigned to each circuit breaker pole position.
  - 2. Provide two columns, odd numbers in left column, even numbers in right column, with 3-inch-wide line for typing connected load information.
- E. Circuit breaker identification
  - 1. Provide permanent identification number in or on panelboard dead-front adjacent to each circuit breaker pole position. Square D adhesive is approved, other adhesives by specific prior approval only.
  - 2. Horizontal centerline of engraved numbers to correspond with centerline of circuit breaker pole position.

3 EXECUTION

3.01 PREPERATION

- A. Meet all requirements as specified in section 260500.

3.02 INSTALLATION

- A. Meet all requirements as specified in section 260500.



B. Install engraved on the inside of panels, visible when door is opened.

C. Ensure labels are the following color:

Power Type	Background Color	Text Color
Normal	Black	White
Emergency	Yellow	Black
UPS	Red	Black

D. Switchgear, Distribution or Panelboard: Install engraved labels on face of panel cover centered on and above equipment door. Provide engraved black label with white text for equipment name. Provide engraved red label with white text with calculated equipment available fault current. Equipment with protective devices rated 1600 Amps or greater shall included an engraved red label with white text indicating nominal system voltage, available fault current, clearing time of overcurrent protective device and date in which label is applied. Include are-flash hazard warning labels on equipment meeting requirements of NEC 110.21(B) located so as to be clearly visible to qualified persons before examination, adjustment, servicing or maintenance of the equipment.

E. Feeder Breaker: Install engraved label adjacent to breaker serving switchgear, distribution or panel board. Ensure label has equipment name.

F. Transformer: Install Engraved Label on face of transformer clearly indicating transformer name, Serving, and served load. See example below.

<b>XMFR-Z</b>
FED FROM: PANEL X
FEEDS: PANEL Z

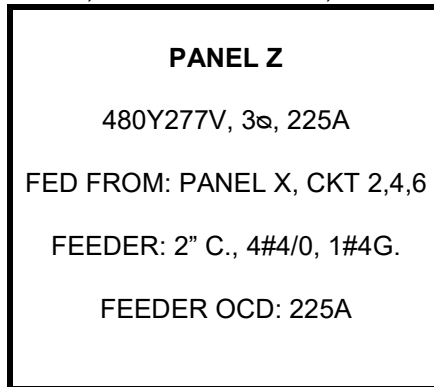
G. Equipment: Install engraved label on each major piece of electrical equipment, including but not limited to disconnect switches, motor starters, relays, contactors, time switches, override switches, and variable speed drives. Ensure label includes equipment name, where it is fed from, the equipment's voltage, phase and amperage, and if applicable what the equipment feeds. See example below. Where indicated on drawings, provide label with equipment available fault current at local disconnect serving equipment. Fault current labels shall be red with white text.

<b>EQUIPMENT Z</b>
FED FROM: PANEL Z, CKT 3,5,7
480V, 3 $\phi$ , 100A OCD



H. Branch Circuit Panelboards:

1. Install permanent label on panel cover inside door area adjacent to main breaker or at top above branch breakers. For the panel, ensure label indicates voltage phase and amperage of panel, feeder source, feeder wire size, feeder conduit size, and feeder breaker or fuse size.



2. Provide typewritten panel directories with protective, clear transparent covers, accurately accounting for every breaker installed, including spares. Ensure schedules use the actual room designations assigned by name or number near completion of the Work and not the space designation on the Construction Drawings.

I. SYSTEMS:

1. Complex control circuits may utilize any combination of colors with each conductor identified throughout, using wraparound numbers or letters. Use the number or letters shown where the Drawings or operation and maintenance data indicate wiring identification.
2. Label the fire alarm and communication equipment zones, controls, indicators, etc. with machine printed labels or indicators appropriate for the equipment installed, as supplied or recommended by the equipment manufacturer.
3. Coordinate color coding with facility engineer prior to applying.

J. JUNCTION AND PULL BOXES

1. Provide color coding for junction boxes by voltage and power type.
2. Use black indelible marker to indicate circuit and voltage contained within. Example: If circuit is from 208V 3phase Panel A circuit 1, 3, 5, the label would be "Panel A, Circuit 1, 3, 5, 208V".

K. CONDUITS

1. Provide color coding for conduits by voltage and power type. Wrap electrical tape around the conduit and label the conduits with the circuits.
2. For conduits 2 inches and larger or with single points of connection to equipment. Write on the conduit the serving panel and circuit connection within 6 inches of each conduit termination into junction box, panel, equipment or similar with black indelible marker. Example: If conduit entering pull box is from Panel A circuit 1, 3, 5, the conduit label would be "Panel A, Circuit 1, 3, 5". Not intended for general branch circuit wiring.

L. ONE-LINE DIAGRAM

1. Provide a laminated one-line diagram showing the distribution system in the electrical room, diagram to include but not limited to disconnects, circuit breakers, panels, switchboards, feeders, transformers, conduit, and incoming/outgoing distribution feeds. Do not show branch wiring or conduits.

3.03 TESTS

- A. Meet all requirements as specified in section 260500.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- A. Section Includes:
  - 1. Switchboards.
  - 2. Distribution panelboards.
- B. Related Sections:
  - 1. Section 260553, Identification for Electrical Systems.
  - 2. Section 337173, Electrical Utility Services.
  - 3. Section 260526, Grounding and Bonding for Electrical Systems.
  - 4. Section 262800, Low-Voltage Circuit Protective Devices.

1.02 SYSTEM DESCRIPTION

- A. Electrical Service and Distribution System: 480Y/277 volts, 3-phase, 4 wire, wye connected system.
- B. Electrical Distribution System: 208Y/277 volt, 3-phase, 4 wire wye connected system.
- C. Existing Electrical Service and Distribution System to Remain: 120/240V, 1-phase, 3 wire system.

1.03 SUBMITTALS

- A. Provide Shop Drawings and Product Data for the Following Equipment:
  - 1. Switchboards.
  - 2. Distribution panelboards.
- B. Provide the following operating, maintenance and installation instructions from the manufacturer for project closeout, see additional documentation requirements in Section 260500:
  - 1. Switchboards.
  - 2. Distribution panelboards.

1.04 REGULATORY REQUIREMENTS

- A. Conform to requirements of the NEC, latest adopted version with amendments by local AHJs.
- B. Furnish products listed by UL or other testing firm acceptable to AHJ.

- C. Conform to requirement of the serving electric utility.

## 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Switchboards: Cutler-Hammer, General Electric, Siemens, Square D, Eaton or approved.
- B. Distribution Panelboards: Cutler-Hammer, General Electric, Siemens, Square D, Eaton or approved.

### 2.02 MATERIALS

- A. Standards: Comply with requirements of UL 67, NEMA PB1 and NEC 384 in construction of switchboards.
- B. Switchboards
  - 1. Enclosures
    - a. Free standing, dead front with front accessibility.
    - b. Framework constructed of formed, code gauge steel, rigidly welded and bolted together to support all cover plates, bussing and component devices during shipment and installation bolt steel base channels to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting.
    - c. Provide each section with individually removable top plate and open bottom to permit installation and termination of service and feeder raceways.
    - d. Removable Front Covers: Screw attached.
    - e. Provide removable hinge pins on all hinged doors.
    - f. Paint interior and exterior surfaces. Medium light gray finish applied by electro-deposition process over an iron phosphate pretreatment.
  - 2. Bussing
    - a. Material: Extruded aluminum plated by ALTAN 70 or 80 process.
    - b. Bus supports, connections and joints bolted together with hex-head bolts and Belleville washers.
    - c. Ground Bus: Full length of switchboard, 50 percent of phase bus capacity.
    - d. Neutral Bus: 100 percent rated, full length of switchboard.

3. Provide fully rated integrated equipment rating greater than the available fault current. Where available fault current is 90% or more of a standard equipment rating, the minimum acceptable equipment fault current rating shall be at least the next higher manufacturer standard rating. See drawings for preliminary available fault currents. Contractor to verify available fault current for final installation. Series rated switchboards are not acceptable.
4. Lugs: Compression type rated for both aluminum and copper conductors.
5. Circuit Breakers
  - a. Provide electronic, adjustable trip, circuit breakers rated 600A and larger.
  - b. Provide molded case thermal magnetic circuit breakers, less than 600A.
  - c. Provide the units with provisions for padlocking in the "OFF" position.
  - d. Operating handle position to clearly indicate device contact position, "ON" or "OFF".
  - e. Provide circuit breakers rated for the available fault current and suitable for use as service equipment.

C. Distribution Panelboards

1. Enclosures
  - a. Flush Panelboards Rated 600 Amp or Less: Maximum enclosure depth, 5-3/4 inches.
  - b. Wiring Gutter Size: 5 inches at sides, 6-inch top and bottom.
  - c. Finish: Galvanized metal.
2. Bussing

SWITCHBOARDS AND PANELBOARDS  
SECTION 26 2400-4

- a. Aluminum bar with suitable electroplating (tin) for corrosion control at connection.
  - b. Provide ground bar to accommodate specified terminal lugs.
  - c. Pre-drill bus for bolt-on type circuit breakers.
  - d. Provide feed through lugs for field inter-connection of multi-section flush panel sections.
  - e. When distribution panel is feeding isolated ground circuits, provide isolated ground bar, insulated from panelboard enclosure, to accommodate specified terminal lugs.
3. Provide fully rated integrated equipment rating greater than the available fault current. Where available fault current is 90% or more of a standard equipment rating, the minimum acceptable equipment fault current rating shall be at least the next higher manufacturer standard rating. See drawings for preliminary available fault currents. Contractor to verify available fault current for final installation. Series rated switchboards are not acceptable. Minimum rating is 10,000 amps.
4. Lugs: Compression type rated for both aluminum and copper conductors.
5. Breakers: Bolt-on type.
6. Covers
- a. Hinged door with flush lift latch and lock, two keys per panel. Key all distribution panelboards alike.
  - b. Paint all surfaces with medium light gray finish suitable for field painting to match wall finish.
  - c. Surface panels to have metal trim covers with no sharp edges or corners. Surface panel enclosure finish to match trim cover.

- d. Where two or more panels are installed side-by-side, provide covers of same height with each trim independently removable without disturbing the other sections.
- e. Where panels are mounted in finished interior areas in normal view of the building occupants, paint covers to match adjacent wall surface.

### 3 EXECUTION

#### 3.01 INSTALLATION

- A. General: Equipment arrangement in electrical room is based on one manufacturer. Coordinate space requirements with equipment supplier. Maintain Code required clearances and manufacturer's recommended clearances.
- B. Switchboards:
  - 1. Install switchboards as directed by manufacturer's installation instructions.
  - 2. Install equipment in conformance with work space requirements of NEC 110.26.
  - 3. Locate equipment in rooms or spaces dedicated to such equipment, NEC 110.26(F). Coordinate with other Divisions of work.
- C. Distribution Panelboards:
  - 1. Install distribution panelboards as directed by manufacturer's installation instructions.
  - 2. Install distribution panelboards surface or flush mounted in accessible locations as indicated on Drawings. Maintain or exceed minimum clearances required by code.
  - 3. Where flush panels are installed, verify available recessing depth and coordinate wall framing with other Divisions.
  - 4. Feeder conductors to enter directly in line with lug terminals wherever practicable. Feeder conductors, except ground and neutral, not to exceed 45-degree deflection from raceway entry to feeder phase lugs.
  - 5. Paint panel cover and surface mounted enclosure (if surface allowed) to match finished wall color where panels are located in finished spaces.
  - 6. Where panels are installed flush, provide two spare conduits from panel to accessible space above the panel.



7. Where panels are installed flush in fire rated walls, maintain fire rating of wall assembly.

3.02 CLEANING

- A. Thoroughly clean the exterior and the interior of each switchboard and distribution panelboard in accordance with manufacturer's installation instructions.
- B. Vacuum construction dust, dirt and debris out of each switchboard and distribution panelboard.
- C. Where enclosure finish is damaged, touch up finish with matching paint in accordance with manufacturer's specifications and installation instructions.

END OF SECTION

1 GENERAL

1.01 REQUIREMENTS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Provide wiring devices required for a complete and code compliant installation that meets and/or exceeds the requirements of the contract documents.
- C. Coordinate, receive, mount, connect, and place into operation all equipment unless otherwise noted. Provide all conduit, wire, connectors, hardware, and other incidental items necessary for properly system as described herein and shown on the plans. Maintain performance criteria stated by manufacturer without defects, damage, or failure. Comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- D. Consult manufacturer for best practices including but not limited to location, quantity, configuration, and installation.

1.02 SUBMITTALS

- A. Meet all requirements as specified in section 260500.

1.03 QUALITY ASSURANCE

- A. Meet all requirements as specified in section 260500.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Meet all requirements as specified in section 260500.

1.05 WARRANTY

- A. Meet all requirements as specified in section 260500 and as noted below.

2 MATERIALS

2.01 MANUFACTURERS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Hubbell, Pass & Seymour and Leviton.

2.02 MATERIALS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Make sure wiring devices are specification grade with special devices as noted on the Drawings. Furnish a matching cap for all special purpose devices that do not have the common 120-volt NEMA 5-15R or 5-20R configuration.

- C. Make sure all lighting switches and duplex receptacles installed are by the same manufacturer and have identical appearance and characteristics, unless noted otherwise.
- D. Ensure finish for all devices matches existing color scheme.
- E. WALL SWITCHES
  - 1. Characteristics: Toggle type, quiet acting, 20-amp, 120/277 volt, UL listed for motor loads up to 80 percent of rated amperage.
  - 2. Pilot Light Switches: Lighted handle, toggle type, red unless noted otherwise, neon pilot lamp. Pilot lamp energized when load is energized.
  - 3. Key Switches: 20-amp/120-277-volt, black key guide. Thermal Motor Switches: Toggle type, 20-amp/120-277 volt, UL listed for motor loads up to 80 percent of rated amperage.
  - 4. Appearance: Provide lighting switches and receptacles of common manufacturer and appearance. Cover plate color to be gray unless otherwise noted.
- F. RECEPTACLES
  - 1. Finish: Same exposed finish as switches. Receptacles connected to emergency circuits, red finish. Receptacles connected to non-emergency circuits to be gray unless otherwise noted.
  - 2. Characteristics: Straight parallel blade 20-amp, 125-volt, 2 pole, 3 wire grounding.
  - 3. Provide Tamper Resistant receptacle in areas where children are likely to be present per NEC.
  - 4. Isolated Ground Receptacle: Orange finish with isolated ground.
  - 5. Isolated Grounding Surge Suppressor Duplex Receptacles: 15-amp, 120-volt, specification grade, three level MOV protection for phase to neutral, phase to ground, and neutral to ground. Indicator light on continuously when protection is active. Indicator light flashes when protection circuit has failed.
  - 6. Ground Fault Interrupter: Feed through type, 20-amp, 125VAC, specification grade.
  - 7. Wet Locations: Weatherproof receptacles installed in wet locations, approved for location and use.
    - a. Provide cord caps for utilization equipment connected to wet location receptacles with barrel type plug.
    - b. Provide continuous use cover with cover capable of closing over energized cord cap with bottom aperture for cord exit.

8. Special Purpose Receptacles: Refer to Drawings for NEMA Standard Specification.

G. FINISH PLATES

1. Material: 18 percent chrome, 8 percent nickel, Type 302 stainless steel, smooth satin finish metal.
2. Finish Plates: Finish plates to be metal with gray finish unless otherwise noted.
3. Telephone/Signal System Device Plates: Activated outlets to have coverplate to match modular jack.

H. SURFACE COVERS

1. Material: Galvanized or cadmium plated steel, 1/2 inch raised industrial type with openings appropriate for devices installed on surface outlets.
2. Cast Box and Extension Adaptors: Aluminum, with gasket, blank.

3 EXECUTION

3.01 PREPERATION

- A. Meet all requirements as specified in section 260500.

3.02 INSTALLATION

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Install devices and finish plates plumb with building lines and equipment cabinets.
- C. Wall Mounted Receptacles: Install with long dimensions oriented vertically at centerline height shown on Drawings or specified herein.
- D. Vertical Alignment: When more than one outlet is shown on Drawings in close proximity to each other, but at different elevations, align the outlets on a common vertical center line for best appearance.

3.03 TESTS

- A. Meet all requirements as specified in section 260500 and as noted below.
- B. Wiring Device Tests: Test wiring devices to ensure electrical continuity of grounding connections, and after energizing circuitry, to demonstrate compliance with requirements. Test receptacles for line to neutral, line to ground and neutral to ground faults. Correct any defective wiring.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- A. Section Includes:
  - 1. Toggle type disconnect switches.
  - 2. Manual motor starters.
  - 3. Safety switches.
  - 4. Fuses.
  - 5. Circuit breakers.
  - 6. Fuse cabinet.
- B. Related Sections:
  - 1. Section 262400, Switchboards and Panelboards.

1.02 SYSTEM DESCRIPTION

- A. Provide disconnect switches as required by NEC for a complete and operational electrical system.

1.03 SUBMITTALS

- A. Provide product data for toggle type disconnect switches, manual motor starters, and safety disconnect switches.
- B. Provide product data for project closeout, see Section 260500 for additional documentation requirements.
- C. Product Data:
  - 1. Provide instantaneous let-through current curves and average melting time current curves for fuses supplied to project.
  - 2. Provide product data and time/current trip curves for circuit breakers supplied to project.

1.04 REGULATORY REQUIREMENTS

- A. Conform to requirements of the NEC, latest adopted version with amendments by local AHJs.
- B. Furnish products listed by UL or other testing firm acceptable to AHJ.

2 PRODUCTS

2.01 MANUFACTURERS

- A. Toggle Type Disconnect Switches: Arrow-Hart, Bryant, Hubbell, Leviton, Pass & Seymour, Slater, or approved.
- B. Manual Motor Starters: Cutler-Hammer, Siemens, Square D, or approved.
- C. Safety Switches: Cutler-Hammer, General Electric, Siemens, Square D, or approved.
- D. Fuses: Bussmann Division, McGraw-Edison; Shawmut Division, Gould Electronic, Littelfuse, or approved.
- E. Circuit Breakers: Cutler-Hammer, General Electric, Siemens, Square D, or approved.
- F. Fuse Cabinet: Bussmann, Circle AW, Gould-Shawmut, Littelfuse, Siemens, Square D, or approved.

2.02 TOGGLE TYPE DISCONNECT SWITCHES

- A. Rating: 120-volt, 1-pole, 20-amp, 1 HP maximum.
- B. Enclosure: NEMA 1 indoors, NEMA 3R raintight outdoors.

2.03 MANUAL MOTOR STARTERS

- A. Characteristics
  - 1. Quick-make, quick-break.
  - 2. Thermal overload protection.
  - 3. Clearly label device for maximum voltage, current and horsepower.
  - 4. Square D, Class 2510.
- B. Enclosure: NEMA 1 indoors, NEMA 3R raintight outdoors.

2.04 SAFETY SWITCHES

- A. Heavy duty, fused type, dual rated, quick-make, quick-break with fuse rejection feature for use with Class R fuses only, unless another fuse type is specifically noted.
- B. Enclosures NEMA 1 indoors, NEMA 3R raintight outdoors.
- C. Switches clearly marked for maximum voltage, current and horsepower.
- D. Equip enclosure with defeatable cover interlock.
- E. Switches rated for maximum available fault current.

2.05 COMBINATION STARTERS

LOW VOLTAGE CIRCUIT PROTECTIVE DEVICES  
SECTION 26 2800-3

- A. Heavy duty, fused type, dual rated, quick-make, quick-break with fuse rejection feature for use with Class R fuses only, unless other fuse type is specifically noted.
- B. Enclosures NEMA 1 indoors, NEMA 3R raintight outdoors.
- C. Clearly mark switches for maximum voltage, current and horsepower.
- D. Provide coil voltage coordinated with control requirements.
- E. Provide thermal overload units sized to equipment nameplate rating.
- F. Provide one N.C. and one N.O. auxiliary contacts.
- G. Provide pre-wired hand/off/auto switch and start button.

2.06 FUSES

- A. Characteristics: Dual element, time delay, current limiting, nonrenewable type, rejection feature.
- B. Combination Loads: Class RK1, 1/10 to 600-amp, UL Class L, above 600 amps.
- C. Motor Loads: UL Class RK5, 1/10 to 600 amp.
- D. Fuse pullers for complete range of fuses.

2.07 MOLDED CASE CIRCUIT BREAKERS

- A. One, two or three-pole bolt on, single handle common trip, rated 15 to 800-amp Drawings.
- B. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
- C. Calibrate for operation in 40C ambient temperature.
- D. 15 to 100 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.
- E. Greater than 100 Amp Breakers: Variable magnetic trip elements set by a single adjustment. Provide push-to-trip button on cover on breaker for mechanical tripping.
- F. Provide removable load lugs, UL listed for compression type lugs, copper conductors only.
- G. Provide all circuit breakers series rated and when series combination ratings are applied, identify all equipment enclosures as required by NEC 110-22.

3 EXECUTION

3.01 INSTALLATION

LOW VOLTAGE CIRCUIT PROTECTIVE DEVICES  
SECTION 26 2800-4

- A. Provide disconnect switch at each motor location within 5 feet unless otherwise noted.
- B. Motors within sight of and not more than 20 feet from motor branch circuit device do not require a disconnect switch at the motor. Provide locking device on circuit protective device.
- C. Recessed fractional horsepower exhaust ceiling or wall fan units; no disconnect switch required at motor if unit is recessed, unless shown otherwise on Drawings.
- D. Switches disconnect all phase legs.
- E. Coordinate fuse ampere rating with installed equipment. Fuse ampere rating variance between original design information and installed equipment, size in accordance with Bussmann Fusetron 40C recommendations. Do not provide fuses of lower ampere rating than motor starter thermal units.
- F. Fuses: For each class and ampere rating of fuse installed, provide the following quantities of spares for quantity of fuses installed:
  - 1. 0 to 24: Provide 6 spare.
  - 2. 25 to 48: Provide 9 spare.
  - 3. 49 and Above: Provide 12 spare.
- G. Circuit Breakers:
  - 1. Provide circuit breakers, specified herein and on Drawings, for installation in panelboards, individual enclosures or combination motor starters.
  - 2. Provide ground fault interrupter circuit breakers for equipment in damp or wet locations.

END OF SECTION



1 GENERAL

1.01 SUMMARY

- A. Section Includes: Metering equipment.
- B. Related Sections:
  - 1. Section 260533, Raceway and Boxes for Electrical Systems.
  - 2. Section 262400, Switchboards and Panelboards.
- C. Fees:
  - 1. Pay all fees levied by serving electric utility to provide service to this project.
  - 2. Obtain fees from serving electric utility prior to submitting a bid.

1.02 SYSTEM DESCRIPTION

- A. Utility Company Requirements: Comply in every respect with requirements of serving electric utility pertaining to equipment installed by Division 26.
- B. Service Lateral Raceways: Provide secondary service lateral raceways terminated at current transformer section of service entrance equipment.
- C. Metering Equipment Enclosure: Provide equipment physical size and internal support structure as required by serving electric utility.

1.03 SUBMITTALS

- A. Provide shop drawings and product data for the metering equipment.

1.04 REGULATORY REQUIREMENTS

- A. Conform to requirements of the NEC, latest adopted version with amendments by local AHJs.
- B. Furnish products listed by UL or other testing firm acceptable to AHJ.
- C. Conform to requirement of the serving electric utility.

2 PRODUCTS

2.01 MANUFACTURERS

- A. Meter Base: Circle AW or approved.
- B. Metering Equipment Enclosure: General Electric, Square D, Cutler-Hammer, or approved.

2.02 METERING EQUIPMENT

- A. Meter Base: Surface mounted, NEMA 3R, meter socket enclosure. Provide meter base(s) for energy/demand and reactive energy/demand bases as required by serving electric utility.
- B. C.T. Enclosure: Provide enclosure that meets the serving utility company's requirements. Construct as an integral part of the main distribution switchboard.
- C. Terminal Cabinet: Provide terminal cabinet that meets the serving utility company's requirements. Construct as an integral part of the main distribution switchboard.
- D. Provide fault withstand rating greater than the utility determined available fault current.

3 EXECUTION

3.01 INSTALLATION

- A. Meter Bases: Locate to provide acceptable access for meter reading and maintenance. Locate to minimize risk of physical damage.
- B. Metering Equipment: Install current transformers supplied by serving electric utility.
- C. Verify utility requirements prior to bidding and provide all associated work required by local utility including but not limited to:
  - 1. Service underground primary including conduit, pull cord, excavation and backfill.
  - 2. Underground pull vaults.
  - 3. Pole risers.
  - 4. Transformer pads, vaults, and the like.
  - 5. Secondary service lateral raceways.
  - 6. Grounding of transformers.
  - 7. Service metering equipment.

END OF SECTION