



May 15, 2023

## **Kimball Union Academy Kilton and Welch Dormitory & Faculty Residences**

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**009318 KUA REQUESTS FOR INFORMATION**

1. SUMMARY

This section includes administrative and procedural requirements for requests for information.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		

3. SECTION INCLUDES

Requirements for Construction Manager’s Requests for Information [RFI].

- A. Definition: “Request for Information” and “Request for Interpretation” are the same.
- B. Construction Manager May Request Information: In compliance with General Conditions of the Contract.
- C. Requirements for Requests for Information: The Construction Manager shall:
  - 1. Issue all RFIs. RFIs will not be accepted from trade bidders, subcontractors, or suppliers.
  - 2. Issue the RFI only after confirming the information is not already available.
  - 3. Use a separate RFI form for each topic, question, and request.
  - 4. Sequentially number each RFI.
  - 5. Maintain a log of all RFIs including topic, date issued, date response received.
  - 6. Not use RFIs as a “Request for Substitution”.
- D. Construction Manager’s Requests for Information After Bidding or After Contract Award: During bidding and pricing, the Construction Manager is required to study and understand

the Contract Documents, to compare the Contract Documents with each other, and to report errors, inconsistencies, and ambiguities discovered.

1. By executing the Contract for Construction, the Construction Manager affirms that the Construction Manager understands the Contract Documents. Consequently, there should be few RFIs after bidding and after Contract award.
  2. The Construction Manager shall avoid unreasonable RFIs. “Unreasonable RFIs” are RFIs which can be answered by information already available to the Construction Manager. The Architect may request payment from the Owner for costs associated with responding to excessive, unreasonable RFIs. The Owner may deduct excessive, unreasonable RFI costs from payments due to the Construction Manager.
- E. RFI Form: Submit RFIs electronically on a form approved by the Architect. The RFI shall include:
1. Unique RFI number [only one RFI per form and number].
  2. Date and time RFI is received by the Architect.
  3. Name and contact information of person and organization originating the RFI.
  4. Contract Document references: drawing and detail numbers, specification paragraphs.
- Substitution Requests: The Architect will not respond to substitution requests made via RFI. See Section 012500 - Substitution Procedures.
- F. RFI Response: The Architect will respond in writing within 10 business days.
- G. Priority RFIs: The Construction Manager may request priority, expedited response from the Architect for a maximum of 10 percent of total RFIs.
1. The Architect will endeavor to respond to Priority RFIs within 5 working days.
- H. Limitations of Architect’s Response: The Architect’s response is an interpretation and not a “Construction Change Directive” or any other modification to the Contract Documents.
1. Contract Changes: Comply with Conditions of the Contract.

END SECTION 009318 KUA REQUESTS FOR INFORMATION

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**011100 KUA SUMMARY**

1. SUMMARY

This section summarizes the project information and the contract work.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Declarations		The Architect requests Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs) be requested of all subcontractors in Divisions 3 – 15. If not available, the CM and associated subcontractors must demonstrate that an adequate effort has been made to procure this information.
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		

3.1 PROJECT INFORMATION

- A. Project Name: “KUA Kilton/Welch Dormitories & Faculty Residences”
- B. Project Location: 31 & 37 Main Street, Meriden, NH 03770
- C. Owner: Kimball Union Academy
- D. Project Team to Date:

Owner: Tyler Lewis - Head of School  
[tlewis@kua.org](mailto:tlewis@kua.org)  
1-603-469-2111

Doug Plummer - Director of Facilities and Operations  
[dplummer@kua.org](mailto:dplummer@kua.org)  
1-603-469-2152

Gerard Murphy – CFO  
[gmurphy@kua.org](mailto:gmurphy@kua.org)  
[1-603-469-2162](tel:1-603-469-2162)

Stacey Summerfield – Director of Institutional Advancement

[ssummerfield@kua.org](mailto:ssummerfield@kua.org)

1-603-469-2125

Larry Osmer – Owner’s Representative & Director of Capital Projects

[losmer@kua.org](mailto:losmer@kua.org)

1-603-469-2158

1-617-719-9835 (cell)

Architect:

Vermont Integrated Architecture, PC  
PO Box 862  
Middlebury, VT 05753

Andrea Murray, AIA, NCARB, LEED AP – Principal

[andrea@vermontintegratedarchitecture.com](mailto:andrea@vermontintegratedarchitecture.com)

Stefan Richter, AIA, LEED AP, CPHC

Project Architect (Main Point of Contact During Construction)

[stefan@vermontintegratedarchitecture.com](mailto:stefan@vermontintegratedarchitecture.com)

802-989-7249

Civil Engineer:

Engineering Ventures, PC  
85 Mechanic Street, Suite E2-3  
Lebanon, NH 03766  
Nicholas Fiore

[nikf@engineeringventures.com](mailto:nikf@engineeringventures.com)

(603) 442-9333

Structural Engineer:

Engineering Ventures, PC  
208 Flynn Avenue, Suite 2A  
Burlington, VT 05401  
Julie Reilly, P.E., Principal  
[julier@engineeringventures.com](mailto:julier@engineeringventures.com)  
802-863-6225

MEP FP Engineer:

Engineering Services of Vermont  
9 Washington St, Rutland, VT 05701  
(802)-855-8091

Claus Bartenstein (Electrical)

(802)-855-1136 (cell)

[Claus.bartenstein@esvtllc.com](mailto:Claus.bartenstein@esvtllc.com)

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Dan Dupras (Mechanical, Plumbing, Fire Protection)

[Daniel.dupras@esvtllc.com](mailto:Daniel.dupras@esvtllc.com)

Geotechnical  
Engineering:

S.W. Cole Engineering, Inc.  
10 Centre Road  
Somersworth, NH 03878-2926  
Tyler S. Demers, P.E., Geotechnical Engineer  
603-841-1213

### 3.2 WORK IN CONTRACT DOCUMENTS

#### A. Contract Summary:

1. Kimball Union Academy (KUA) is a private secondary school located in Meriden, NH. KUA is planning to renovate and expand two dormitories –Kilton Hall, and Welch Hall on its campus. With the goal of increasing the number and quality of dormitory-based faculty residences while maintaining the same number of dormitory beds, the project also seeks to provide more welcoming and comfortable gathering spaces and more convenient and functional student amenities.

Ideally, these projects will be models of beautiful, functional architecture that exemplify care and healthfulness for human inhabitants and the environment alike. With an eye toward net-zero facilities, consideration of site design, materials, energy efficiency and energy sources, and embodied carbon of materials and methods will guide the design.

2. The project will likely be constructed in phases, but ultimately the project will include additions to the two existing buildings.

#### KILTON:

- 20 new student beds
- 8 Renovated beds
- 2 new faculty residences
- 1 renovated faculty residence

#### WELCH

- 19 new student beds
- 1 new faculty residence
- 1 renovated faculty residence

3. The new buildings will have poured concrete foundations, be of wood-framed construction, and will have a high-performance building envelope and fenestration that exceeds requisite energy codes in an effort to achieve all-electric (fossil-fuel-free), net-zero ready energy buildings. We are including both ground-source heat pumps and air-source heat pumps for heating, cooling, and domestic hot water. The buildings include high-efficiency heat-recovery ventilation systems and domestic water drain heat recovery. The buildings will also include provisions for easy connection to future photovoltaics to allow the net-zero ready building to be net-zero energy when the photovoltaics are brought online in the future. Building monitoring systems will be provided for observation/review by occupants

and building managers to confirm that the building is performing as designed during its operation. Building Envelope and MEP Commission agents have been retained by the owner to review, test, and report on the quality of installed work. Special attention and care has been made for materials selections to prioritize low-embodied carbon materials (i.e. concrete mix design, GWB, various insulation types, select finishes, and the use of wood vs. steel, etc.), non-toxic and low or zero VOC materials (i.e. paints, coatings, sealants, caulking, millwork, finishes, etc.) whenever possible. Waste management, including minimizing construction debris and waste along with recycling, is a priority.

- B. Contract Does Not Include:
  - 1. Furnishings, fixtures, and equipment, unless required by the Contract Documents.
  - 2. Hazardous materials abatement.
  
- C. Owner Furnished and Contractor Installed Items: Comply with Specification Section 016402 “Owner Furnished Requirements.”
  
- D. Work Limits & Campus Rules: The Construction Manager has developed a site logistics plan that defines the work limits, also shown on site plan(s). KUA will be operating as a fully functioning school during much of the course of construction. As such the Construction Manager and all subcontractors must adhere to the “KUA Rules and Regulations 2023” (see appendix).
  
- E. Permits, Inspections: Obtain and pay for all work permits and inspections required by authorities having jurisdiction. Building permits have been or will be obtained by the Owner & Design Team prior to construction start.
  - 1. Legal Notices: Provide all legal notices required by authorities having jurisdiction.
  
- F. Utility Company Fees:
  - i. Owner to pay Electric Utility Connection fees.
  - ii. Owner to pay for Electrical Usage during project construction.
  - iii. Owner to pay for new Water Meter
  - iv. Owner to pay for water usage during construction.
  
- G. Restrictions on Work Hours and Days: Contractors to have full access to the site and existing building between 7 am and 5pm during non-holiday weekdays. As required, access may be permitted on holidays or weekends, or daily from 5am to 7pm with the express permission of the owner. At least 24 hours notice on such occasions is requested.
  
- H. Restrictions on Advertising, Promotion, and Publication: This project and the Owner’s name may not be used for any advertising, promotions, or in any publications without the Owner’s written prior permission. If any advertising, promotion, or publication is permitted, the Architect shall be credited.

- I. Restrictions on Labor:
  - 1. Comply with all applicable labor regulations.
  - 2. Employ competent and experienced workers.
  - 3. Avoid jurisdictional disputes, strikes, work stoppages, and delays.
  - 4. Pay all costs associated with labor related schedule delays.
- J. Restrictions on Noise: Comply with requirements of authorities having jurisdiction specific to noise pollution regulation.

### 3.3 SUBCONTRACTING

Organization of the Specifications into divisions, sections, and articles, and arrangement of Drawings shall not control the Construction Manager in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

- A. Contracts between the Construction Manager and Subcontractors: Contracts between the Construction Manager and Subcontractors shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Construction Manager by the terms of the Contract Documents and to assume toward the Construction Manager all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Construction Manager, by the Contract Documents, assumes toward the Owner and Architect.
- B. Construction Manager May Subcontract: The Construction Manager may subcontract portions of the work and is solely responsible for subcontracting and the limits of each subcontract. The Construction Manager is responsible for all work of the Contract including work which is subcontracted and work which is not subcontracted.
- C. Restrictions on Subcontracting: The Contract Documents may restrict subcontracting of certain assemblies for "single point responsibility".
- D. Subcontracting Errors and Claims Related to Subcontracting Disputes: Subcontracting is difficult and error prone. Since the Construction Manager is solely responsible for subcontracting and the limits of each subcontract, the Construction Manager is solely responsible for subcontracting errors. Work indicated anywhere in the Contract Documents is included in the work of the Contract and is included in the Contract Amount. The Owner will not pay for change orders or increased costs related to subcontracting disputes or errors including claims that no subcontractor "owns" the work indicated. The Construction Manager "owns" the entire work of the Contract. The Construction Manager is responsible for all work of the Contract including work which is subcontracted and work which is not subcontracted. Work not subcontracted shall be provided by the Construction Manager at no additional cost to the Owner.



- E. Drawing References: Specifications may include references to specific drawings to assist the reader. These references are not a complete list of all applicable drawings and do not limit the scope, extent, or locations of work specified.
  - F. Imperative Mood: Specifications typically use imperative mood sentences. In the imperative mood, the subject of the sentence is not typically expressed. Imperative mood sentences take the form of commands such as “Do this.” The Construction Manager is the subject of imperative sentences. Any questions that may arise as the result of this mood shall be directed to the architect prior to construction occurring.
  - G. Revisions to Documents Issued for Construction: For convenience, revisions will be indicated by double underlined text, strike thru text, and other graphic means (usually colored text). Due to clerical error, not all revisions may be graphically indicated. Compare revised documents to original documents and confirm all revisions indicated.
- 3.4 COMPLIANCE WITH AUTHORITIES HAVING JURISDICTION AND REQUIREMENTS OF KUA  
All work and services provided by the Construction Manager shall comply with all codes, regulations, standards, and requirements of authorities having jurisdiction. See Section 014000 “Quality Requirements”, *Item-1.1 A*.
- A. The Construction Manager is not required to confirm the Contract Documents comply with codes and requirements of authorities having jurisdiction.
  - B. All questions or concerns about code requirements shall be directed to the Project Architect prior to construction of any element in question.

END SECTION 011100 KUA SUMMARY

## 012200 KUA UNIT PRICES

### 1. SUMMARY

- A. Unit Prices shall be used to adjust the Contract Amount when changes in the work involving unit price items are made with the Owner's prior approval.
- B. Unit prices apply to increases and decreases in work. No Unit Price work shall be done without first obtaining the Owner's written authorization in the form of a Contract Modification issued by the Owner.
- C. The Owner will not pay for any Unit Price work done without the Owner's prior written authorization.
- D. Unit Prices Include: Materials, labor, equipment, overhead, bonds, insurance, profit, storage, handling, transportation, and all other costs.
- E. Quantities and Measurements: Quantities and measurements related to work done under Unit Prices are subject to the Owner's independent audit and verification.
- F. Provide advance notice to the Owner and allow the Owner to audit and verify quantities and measurements prior to concealing work.
- G. See Drawing Sheet A-0.2 for Masonry Repair definitions. See specifications for materials, procedures, and expectations.

#### Related Sections:

- 012300 Alternates and Allowances
- 040100 Masonry Restoration
- 073100 Slate Roof Repair and Cladding
- 077000 Roofing Accessories

### 2. SUBMITTAL PROCESS

All unit Prices will be submitted and tracked with an agreed upon spreadsheet created and maintained by the Construction Manager. A blank unit prices matrix will be submitted to the architect and client for written approval prior to being filled out. Unit price schedule to be updated at least with every application for payment or as agreed upon with the client and architect.

### 3. SCHEDULE OF UNIT PRICES

Provide unit costs for the following:

- A. LEDGE REMOVAL
  - i. For Building Foundation
  - ii. For Utility Trenching

END SECTION 012200 KUA UNIT PRICES

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## 012300 KUA ALTERNATES AND ALLOWANCES

### 1. SUMMARY

This section includes administrative and procedural requirements for alternates, and a list of both alternates and allowances for the project. This section applies to all contracts.

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

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

An Allowance is a suggested budget for the scope of work described, but not completely defined at the time of bidding.

Related Sections:

All drawings and specifications included in the construction documentation.

### 2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	-
Product Cut Sheets	X	-
Product Samples	X	
Mock-ups	NA	
Closeout submittals	X	

### 3. PROCEDURES FOR ALTERNATES:

1. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  - i. 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.
2. Retain "Notification" Paragraph below for most projects. Failure to require notification could create problems later.
3. 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 revisions to alternates.
4. Execute accepted alternates under the same conditions as other work of the Contract.

4. PROCEDURES FOR ALLOWANCES:

Allowances: For certain work items, “allowances” are established instead of complete Contract Documents. Allowances may specify a dollar value or a quantity to be included in the Contract Amount.

A. Allowance Procedures:

1. Additional Contract Documents may be issued for allowance items.
2. The Contract Amount will be adjusted to account for the Owner approved differences between the allowance dollar value and the actual dollar value or the allowance quantity and the actual quantity.

B. Construction Manager’s Responsibilities:

1. At the earliest possible time to avoid project delays, advise the Owner and Architect when allowance related decisions are due.
2. Offer suggestions, proposals, and recommendations for each allowance item.
3. Do not make allowance related purchases until after receiving direction from the Owner and Architect.
4. Do not exceed allowance amounts or quantities without the Owner’s preapproval.
5. Provide Change Order information including differences between the allowance dollar value and the actual dollar value or the allowance quantity and the actual quantity.
6. Credit the Owner for trade and other discounts related to the actual purchase.
7. Certify the actual quantities needed plus the quantity of waste and excess material added.
8. Submit certified delivery receipts showing total quantities received.

C. Extra Materials and Products: After installation and acceptance of work related to each allowance, return excess materials and products to suppliers, where possible, for credit to Owner.

1. When return for credit is not possible or feasible, package and deliver extra materials and products to the Owner’s storage facility for Owner’s maintenance stock.
2. Remove and dispose of extra materials and products which the Owner does not want packaged and delivered to the Owner’s storage facility.

D. Allowance Amount Includes: Purchase costs minus trade discounts, temporary offsite storage, freight, delivery to the site, and taxes [for projects subject to taxes].

E. Allowance Amount Does Not Include and the Base Contract Amount Includes: Unloading, handling, hoisting, temporary on site storage, installation, connection, labor, equipment, staging, permits, overhead, profit, and all other expenses and costs.

F. Change Orders Related to Allowances:

1. When Owner approved actual cost or quantity is greater than the allowance amount or quantity, the Construction Manager will be paid for the additional cost

or quantity plus Contract specified Construction Manager overhead and profit only. No other expenses or costs will be added.

2. When actual cost or quantity is less than the allowance amount or quantity, the Construction Manager will credit to the Owner the cost savings plus Construction Manager's overhead and profit.

5. LIST OF ALTERNATES

**BID PACKAGE #1 – March 27, 2023**

1. ADD – Kilton Faculty Residence B in totality to the full project.
2. ADD – Welch Existing Faculty Residence renovations and screen porch.
3. ADD – Kilton Existing Dormitory – Upgrade Existing Wall Insulation
4. ADD – Pave Remaining Service Driveway to just beyond relocated garage.
5. ADD – Reconstruct and Pave Service Drive from relocated garage to service building.
6. ADD or DEDUCT – Windows – Bid European-Style Window Option (will not require insulated surround as with Marvin/Pella flange-style). Wythe, Zola, Optiwin for new construction only.

**BID PACKAGE #2 – May 15, 2023**

1. ADD - New Welch Faculty Residence Fit-Up.
2. ADD - New Kilton Faculty Residence 'A' Fit-Up.
3. ADD - New Kilton Faculty Residence 'B' Fit-Up.
4. ADD - Existing Welch Faculty Residence Renovation, screen porch and envelope upgrade.
5. ADD - Existing Kilton Dorm Lighting upgrade
6. ADD - Upgrade all Heat Pumps to DDC controls with DDC window sensors. (ESVT does not have this as an option in their current specification but more info could be provided via addendum if Mechanical subs request it.)
7. ADD - Add new Air source Heat pumps to Existing Kilton Faculty Residence - existing envelope and HVAC to remain as is with no upgrades involved.

6. LIST OF ALLOWANCES

**BID PACKAGE #1 – March 27, 2023**

1. None.

**BID PACKAGE #2 – May 15, 2023**

1. \$5000 – Medallion for center of plaza between Welch and Kilton. See Architectural Site Plan and

END SECTION 012300 KUA ALTERNATES AND ALLOWANCES

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**012500 KUA SUBSTITUTION PROCEDURES**

1. SUMMARY

This section includes administrative and procedural requirements for product substitutions.

- A. In an effort to ensure maximum open and free competition for this project, wherever possible materials and systems have been specified with “or approved equal (OAE).” If a contractor notices an instance in the documentation where this is not the case, the contractor is welcome to make a recommendation for a substitution to the architect.
  
- B. After bidding, if the Construction Manager would like to suggest the use of materials or manufacturers other than those specified in the Contract Documents, the Construction Manager shall notify the Architect in writing of the requested substitution prior to the installation of any product under consideration – see process outlined herein. If the architect agrees that the product substitution should be considered, the Architect will issue a potential change order (PCO).

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		

3. REQUIREMENTS

- A. Substitution Conditions: Substitutions are discouraged, except under the following conditions:
  - 1. Contractor believes specified item is no longer available.
  - 2. Contractor believes specified item is incorrect, inappropriate, or incompatible.
  - 3. Substitution offers the Owner substantial advantage in quality, time, or cost.
  - 4. Submittal is related to an “or equal” clause in the Contract specifications, which was not addressed during the bidding process.

- B. Substitution Requirements Apply To:
1. Proprietary “named” specifications when the submitted item is not listed in the specifications.
  2. All deviations from the Contract requirements.
- C. Substitution Requirements Do Not Apply To:
1. Performance specifications, unless the submitted item deviates from Contract requirements.
  2. Descriptive specifications, unless the submitted item deviates from Contract requirements.
- D. Substitution Procedure and Contractor’s Requirements:
1. Substitution for Major Items in the project - submit a substitution request to the project design team, noting consequences to the project, as listed in “A” above.
  2. Identify each Contract required item for which the Contractor proposes a substitution.
  3. Refer to specification section, article, paragraph numbers, product names, and models.
  4. Certify the proposed substitution meets or exceeds the Contract requirements.
  5. Provide evidence that proposed substitution meets or exceeds the Contract requirements.
    - a. Provide tabulated side by side comparison of specified item and proposed substitution.
    - b. Directly compare each feature, characteristic, and performance.
    - c. Provide manufacturer’s product data for both specified item and proposed substitution.
    - d. Clearly show origin of all information included on side-by-side comparison.
    - e. Provide details showing how the proposed substitution interfaces with adjacent work.
  7. Certify that Contract required warranty, if any, will be provided for the proposed substitution.
  8. Certify that proposed substitution is coordinated with all related and adjacent work.

9. Provide complete and total cost change information related to the proposed substitution.
    - a. Indicate if Owner’s cost will be higher, the same, or lower [credit to Owner].
    - b. No other costs will be considered other than costs submitted with the substitution request.
  10. Submit proposed substitutions at the earliest possible time.
  11. Allow 10 business days for Architect’s and Owner’s review, except allow 15 days when the Architect’s consultants’ review is also required. Architect’s consultants’ review is required for all proposed substitutions related to the consultant’s work. The above noted workflow and timing is to be included in the submittal procedure and administered by project management software that is required to manage the submittal process.
- E. Appearance Characteristics: For items visible in the completed work, appearance is an important substitution evaluation factor. The Owner and Architect will decide if a proposed substitution has acceptable appearance. Proposed substitutions may be rejected for appearance alone.
- F. Invalid Substitutions: Submittals made without a formal “Substitution Request Cover Sheet” or without following substitution procedures are invalid and any approvals given are invalid.
- G. Substitution Assumptions: Construction Manager bidding and the Contract Amount should only be based on the Contract Documents.
1. Do not assume any proposed substitutions including “or equals” will be accepted prior to substitution requests.
  2. All substitutions require the Owner’s and Architect’s written approval prior to implementation.
4. SAMPLE CONTENT FOR SUBSTITUTION REQUEST COVER SHEET
- A. The following cover sheet format and content is required for all proposed substitutions including “or equals”.
- Contractor or Subcontractor:  
Unique Tracking Number:  
Date of This Request:  
Summary Description of This Proposed Substitution:
- Specification Section and Paragraph Numbers:  
Contract Drawing and Detail References:  
This Request Prepared By:



Conditions: Indicate all conditions that apply to this proposed substitution:

- Substitution requested because specified item is no longer available.
- Substitution requested because specified item is incorrect, inappropriate, or incompatible.
- Substitution requested because it offers the Owner substantial advantage in:
  - Quality
  - Time
  - Cost
- This is an “or equal”.

Evidence: Indicate evidence attached:

- Tabulated side-by-side comparison of specified item and proposed substitution directly comparing each feature, characteristic, and performance.
- Manufacturer’s product data for both specified item and proposed substitution.
- Details showing how the proposed substitution interfaces with adjacent work.
- Certification that warranty, if any required, will be provided as required.
- Certification that this proposed substitution is coordinated with all related and adjacent work.
- Complete cost change information.
- Higher cost to Owner as stated in cost change information
- No change in cost to Owner
- Lower cost to Owner, credit to Owner as stated in cost change information

END SECTION 012500 KUA SUBSTITUTION PROCEDURES

**012600 KUA CONTRACT MODIFICATION PROCEDURES**

1. SUMMARY

This section includes administrative and procedural requirements for handling and processing Contract modifications. This section applies to all prime contracts.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

See Section 012300 Alternates and Allowances for requirements for alternates.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Information	X	Name of Contractor contact for receiving change directive documents.
Sample Forms	X	Sample Change Order Form

3.0 REQUIREMENTS:

3.1 Work believed by the Construction Manager to be a Change in Contract scope shall not be performed without identification and communication of this work to the Architect, and Owner. The Owner is not obligated to compensate the Construction Manager for work performed without notification to the Owner.

3.2 Minor Changes in The Work:

A. Architect will 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." The form is intended to assist the architect in performing obligations as interpreter of the contract document requirements in accordance with the owner-architect agreement and the general conditions. This form is not used to change the Contract Sum or Contract Time.

3.3 Proposal Requests/Potential Change Order:

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

1. Proposal Requests issued by Architect are for information only. "Proposal Requests" (PRs) are initiated by the Architect and "Potential Change Orders (PCOs)" are prepared by the Construction Manager. PCO and PR terminology may be used interchangeably in this project manual. Do not consider them instructions either to stop work in progress or to execute the proposed change.

2. Within time specified after receipt of Proposal Request, submit a PCO 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 Construction Manager's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  
- B. Construction Manager-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Construction Manager may propose changes by submitting a request for a change, or PCO, to Architect.
  1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
  2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  4. Include costs of labor and supervision directly attributable to the change.
  5. Include an updated Construction Manager's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  6. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

- C. Proposal Request Form: Use AIA Document G709 for Proposal Requests, or Construction Manager-specific proposal request form if approved by the design team.

3.4 Change Order Procedures:

- A. On Owner's approval of a Proposal Request, the Construction Manager will issue a Change Order for signatures of Owner, Architect, and Construction Manager on AIA Document G701.
- B. Promptly revise Schedule of Values and Application for Payment forms to record each executed Change Order (CO) as a separate line item and adjust the Contract Sum.
- C. Promptly revise Construction Schedule to reflect change in Contract Time, revise sub-schedules to adjust times for other items of Work affected by the change, and submit with next Application for Payment.

3.5 Construction Change Directive:

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Construction Manager 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.

3.6 Documentation of Change In Contract Sum/Price And Contract Time:

- A. Maintain detailed records of work completed on a time and material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs of changes in Work.
- B. Document each quotation for a change in cost or time with sufficient data to allow evaluation of quotation.
- C. Provide additional data to support computation:
  - 1. Quantities of products, labor, and equipment.

2. Taxes, insurance, and bonds.
  3. Overhead and profit.
  4. Justification for change in Contract Time.
  5. Credit for deletions from Contract, similarly documented.
- D. Support each claim for additional costs or contract modification proposal, with additional information:
1. Origin and date of claim.
  2. Dates and times work will be performed, and by whom.
  3. Time records and wage rates to be paid.
  4. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

END SECTION 012600 KUA CONTRACT MODIFICATION PROCEDURES

**012900 KUA PAYMENT PROCEDURES**

1. SUMMARY

This section includes administrative and procedural requirements for contractor payment. This section applies to all work included in the Construction Manager’s contract.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		
Other Documents		Items listed in 1.1 F below.

1.1 SECTION INCLUDES: General requirements for payment procedures.

A. Schedule of Values: Is a detailed cost break down of the Contract Amount.

1. A “Schedule of Values” is required for the project.
2. Submit the “Schedule of Values” with the proposed contract.
3. Submit the “Schedule of Values” in a format acceptable to Owner and Architect. AIA documents G702 and G703 are recommended.
4. Organize “Schedule of Values” in a clear and legible manner.
5. Itemize general conditions and general requirements costs.
6. Provide a separate cost line item for each major element of work.
7. Provide a summary cost for each of the “Master Format” divisions.
8. Coordinate Schedule of Values with Contract Progress Schedules.
9. Provide additional “Schedule of Values” information requested by Owner and Architect.

B. Schedule of Values Revisions: After approval, the Schedule of Values shall not change, except:

1. Contractor Proposed Changes: The Construction Manager may propose a change and submit evidence to support the proposed change. The change will not be valid unless approved by the Owner and Architect.
2. Owner or Architect Changes: The Schedule of Values shall be changed as directed by the Owner or Architect.

- C. Draw-down Schedule: To assist the Owner in making payments/managing cash flow, submit a Draw-down Schedule at least 15 days prior to the first application for payment. Coordinate Draw-down Schedule with approved Schedule of Values and Contract Progress Schedule. The Draw-down Schedule shall predict the amount of monthly requisitions for payment. Update the Draw-down Schedule as needed during the project.
- E. Payment Procedures: Comply with the Owner-Construction Manager Agreement and the General Conditions of the Contract for Construction.
1. Retainage: Owner will retain 10% of contract value, per the Owner- Construction Manager Agreement. Retainage applies to all payments.
  2. Application for Payment Form: Submit completely filled out copies of AIA G702 and G703.
  3. Application for Payment Information: Include at least the following up to date items:
    - Change Order information including change orders requested, pending, and approved.
    - Schedule of Values.
    - Contract Progress Schedule.
    - Cash Flow Schedule.
    - Long Lead Time item status report.
    - Certification that all Record Documents are up to date.
    - Certification of payment to subcontractors and suppliers previously paid by Owner.
    - Lien waivers for all payments previously paid by Owner.
    - Project photographs if required by the Contract.
    - Certification of Payment of Prevailing Wages.
    - Other information requested by Owner and Architect.
  4. Number of Application for Payment and Substantiation Copies Required: One.
  5. Submit Draft for Review: Submit a draft “pencil” copy of each Application for Payment to the Owner’s Representative, and Architect.
    - a. Scheduling of submission of draft “pencil” copy will be coordinated with weekly project meetings. Allow at least 5 business days for Owner’s Representative, and Architect to review and provide comments.
    - b. Address review comments prior to submitting for Payment.
  6. Payment will be issued within 10 days of approval of the final requisition – sooner, if possible.
- F. Information **Required Before First Application for Payment**: The following must occur/Receipt of the following information is a prerequisite to payment:

1. Schedule Project Accounting Meeting with Owner’s Representatives and Architect to understand accounting requirements specific to funders for the project.
  2. Finalize Schedule of Values.
  3. Contract Progress Schedule.
  4. Cash Flow Schedule.
  5. List of subcontractors and suppliers under contract by date of this submission.
  6. Long Lead Time item status report.
  7. Submittal Schedule coordinated with the Contract Progress Schedule.
  8. Names, telephone numbers including cell phone, pager numbers, and e-mail addresses for Contractor’s managers.
  9. Contractor’s emergency contact information and procedures.
  10. Copies of all permits and communications from authorities having jurisdiction.
  11. Contractor's Certificate of Insurance.
  12. Contractor’s Safety Plan.
  13. Unit Price schedule and information, if required by the Contract.
- G. Information Required Before Final Application for Payment: See “Section 017700 Closeout Procedures”.
- H. Payment for Items or Work Stored Off-Site: No payment will be made for raw materials or stock items stored off site.
- I. Payment for Submittals: Since submittals are important parts of the Contract, payment will be withheld for missing and incomplete submittals.
- K. Payment for Changes in the Contract:
1. Change Orders and Change Directives shall be in writing. Approved Change Orders shall be added to the Schedule of Values as a distinct line item, and billed on a percent-complete basis as with other project scope.
    - a. The Owner will not pay for verbally directed changes in the Contract.
  2. A formal, written Change Order or Change Directive issued or approved by the Owner and Architect is a precondition for payment for changes in the Contract.

END SECTION 012900 KUA PAYMENT PROCEDURES



**013000 KUA ADMINISTRATIVE REQUIREMENTS**

1. SUMMARY

This section includes administrative and procedural requirements for administration of the project.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		

A. Submittal material review and Demonstration of compliance:

- a. Submitted materials as noted in the specification sections shall be reviewed by contractor, vendor, subcontractor, etc.
- b. Submitted materials should include highlights and/or mark-ups calling attention to the areas that demonstrate compliance with contract documents demonstrating that the materials have been reviewed and confirmed as compliant (I.e. meeting or exceeding the requirements of the contract documents.
- c. Submitted materials should include highlights and/or mark-ups calling attention to items that require further selection, direction, or information (i.e. color/finish selections, patterns, options, etc.)

3.1 SECTION INCLUDES: General requirements for Contract and project administration.

A. Construction Manager’s Management Staff Requirements:

- 1. Personnel: The Construction Manager shall supply qualified and experienced personnel to manage the project, both administratively and the physical construction of the project.
- 2. Reassignment or Replacement: Do not reassign or replace management staff, unless preapproved by the Owner. Provide at least one week of advance notice to Owner of proposal to reassign or replace staff. If staff is reassigned or replaced, provide at least 60 working days overlap between existing and new staff to promote a good transition. The Owner and Architect reserve the right at any time during the Contract to request the replacement of Contractor’s management staff with personnel acceptable to the Owner and Architect.

3. On Site: Each Contractor's management staff shall be on site whenever work is in progress on their Contract.
  4. Work Restrictions: The Construction Manager's Management Staff shall manage, supervise, coordinate, plan, and direct the work.
  5. Subcontractor's Management Staff: Each subcontractor's foreman or superintendent shall be on site whenever the subcontractor's employees are on site.
- B. Project Management Software:
1. The Construction Manager shall use a construction industry-specific project management software (like ProCore or approved alternative) to digitally manage submittals, Contract changes, RFIs, photos, and other project information. The Owner, Owner's Representatives, Architect and other prime Contractors shall be assigned accounts to access this software and process information to support the project.
  2. Software workflows to be reviewed and approved by architect prior to commencement of work, including durations for each reviewer in the workflow and overall review duration.
- C. Regular Project Meetings: The General Construction Contractor shall convene regular project meetings to manage the project.
1. Schedule: Once per week on day and at time approved by Owner and Architect.
  2. Agenda: Prepare a written agenda for each meeting including:
    - a. Review of previous meeting minutes.
    - b. Progress schedule including submittal status, long lead items, and critical path items.
    - c. Identify problems which impede planned progress.
    - d. Develop corrective action to maintain planned schedule.
    - e. Project coordination.
    - f. Review of conflicts and other problems, if any, and develop corrective action.
    - g. Review of requisitions for payment.
    - h. Review of in progress record documents.
    - i. Other current business.
  3. Agenda Distribution: E-mail at least 24 hours prior to each meeting.

4. Attendees: Construction Manager, the Owner and/or Owner's Representative, and the Architect and other persons invited by them.
  5. Architect's Consultants: Will attend only when directed by the Architect.
  6. Authority: Each attendee shall have the authority to make binding agreements for their organization.
  7. Meeting Chairperson: The Construction Manager.
  8. Meeting Minutes Prepared By: The Construction Manager.
  9. Meeting Minutes Content:
    - a. Date and time of meeting.
    - b. Meeting location.
    - c. Persons attending and organizations they represent.
    - d. Copy of the meeting agenda.
    - e. Topics discussed at the meeting with a unique identifier for each topic.
    - f. Summary of action items required, persons responsible, and date action due.
    - g. Identification of items resolved.
    - h. Identification of items outstanding and requiring resolution.
  10. Meeting Minutes Distribution: E-mail and/or through the Project Management Software within 48 hours after meeting.
  11. Meeting Minutes Amendments: Attendees may request revision to meeting minutes by written request e-mailed to the author of the meeting minutes within five (5) days after the meeting.
- D. Special Meetings: The Owner, Owner's Project Manager, or Architect may require Special Meetings which may be convened with little advance notice and at which attendance by the Contractors, subcontractors, suppliers, and other parties requested by the Owner or Architect is mandatory and a Contract Requirement.
- E. Preconstruction Meetings: The Architect shall convene a preconstruction meeting prior to beginning work on site. The Construction Manager and their major subcontractors and suppliers shall attend. Agenda shall include at least the following:

1. Creation of project team directory listing contact person for each organization and “on call” schedule. At least one of the Contractor’s personnel shall be “on call” 24/7 for the duration of the Contract.
2. Issuance and review as necessary of Contract Documents.
3. Review of project schedule.
4. Review of required monthly reports and updates.
5. Review of long lead time items.
6. Review of project constraints and work hours.
7. Delivery policies, storage locations, temporary office locations, and temporary facilities.
8. Safety, first aid, and security procedures.
9. Cleaning, housekeeping, and waste removal.
10. Change Order requirements.
11. Progress payment requirements including requisitions, lien waivers, stored materials documents and policy.
12. Submittal requirements, schedules, procedures, regular reports.
13. Record document requirements and procedures.
14. Contract quality control and inspection requirements including special inspection programs.
15. Public disturbance mitigation requirements and noise ordinance.
16. Parking and transportation requirements.
17. Contract implementation and auditing process.
18. Contract closeout, punch lists, warranty requirements.
19. Final payment requirements.
20. Other subjects determined by the Contractor, Owner, and Architect.

- F. Pre-installation Meetings: The Construction Manager and appropriate sub-contractors shall convene pre-installation meetings prior to the first work on site by each subcontractor, each trade, and prior to work of each specification section. Require installers, subcontractors, relevant suppliers, and manufacturer’s representatives to attend. Agenda shall include at least the following:
1. Scheduling, sequence of work, and critical path work.
  2. Submittal and coordination requirements.
  3. Manufacturer’s and installer’s requirements and recommendations.
  4. Potential conflicts, incompatibility problems, and solutions.
  5. Inspection and approval of substrates and supporting work by installers.
  6. Environmental conditions and controls related to installation of work.
  7. Protection of completed work.
  8. Other topics determined by the Contractor.
- G. Architect-Required Pre-Installation Conferences: This project has some lofty performance goals. As a result, the following coordination meetings are required for this project:
1. Envelope Commissioning Pre-Installation Review Meeting (Contractor, Envl. Cx, Architect, All Involved Subs and including MEP subs, Owner)
    - a) & Mock-up Reviews @ weekly Site Visits as needed (Contractor, Envl. Cx, Architect, All Involved Subs and including MEP subs, Owner)
  3. Window Pre-Installation (Contractor, Envl. Cx, Architect, Involved Subs, Owner) – May be coupled with Envelope Commissioning Pre-Installation Review Meeting
    - a) Mock-up Review(s) and testing @ weekly Site Visits as needed (will follow Envelope Commissioning Pre-Installation Review Meeting)
  4. Fire Protection Coordination Meeting - (Contractor, Architect, Involved Subs, Owner) – Must occur prior to shop drawing preparation and may include one follow up meeting.
  5. Doors & Hardware (Contractor, Owner, Architect & Subcontractor) – Contractor to prepare draft submittal prior to this meeting and distribute to participants. Submittal coordination is the subject/focus of this meeting.
    - a) keying (Contractor, Owner, Architect & Subcontractor) - Contractor to prepare draft submittal prior to this meeting and distribute to participants. Submittal coordination is the subject/focus of this meeting.

6. Architectural Concrete at Plaza Pre-Conference w/shop drawings and mock-ups.
  7. MEP coordination review meeting (Contractor, Architect, MEP Engineer, MEP subs, Owner) – Must occur prior to shop drawing preparation and may include one follow up meeting.
- H. Contract Progress Schedules and Reports: Digitally create and provide a Critical Path Method [CPM] progress schedules and reports.
1. Responsibility: Construction Manager is responsible for the Contract Progress Schedule content and the construction sequence and the logistics of the Contract Progress Schedule. The Construction Manager shall be responsible for the creation of the initial Contract Progress Schedule, and the updating and management of it over the course of the project.
  2. Review and Sign-Off: The Contract Progress Schedule shall be reviewed at the Project Pre-Construction Meeting. Any concerns shall be brought to the attention of the Construction Manager, Owner/Owner's Representative, and Architect at that time. This schedule represents assumed coordination between the Construction Manager and its subcontractors.
  3. Updated Contract Progress Schedule Submittals: Prepare and submit with each Application for Payment.
  4. Contract Progress Schedule and Schedule of Values: Make the Contract Progress Schedule work items with the Schedule of Value work items the same.
  5. Distribution: Distribute Contract Progress Schedules and Reports including updates to Owner/Owner's Representative, Architect, subcontractors, suppliers, and all parties related to Contract schedules and deadlines.
- J. Contract Progress Schedule Content: Include at least the following information.
1. All major and critical minor Contract activities.
  2. Sequence and duration of each activity.
  3. Project milestones.
  4. Early start and early finish for each activity.
  5. Late start and late finish for each activity.
  6. Total float time for each activity.
  7. Submittals related to each activity including dates of first submittal and last date for approval.

8. Fabrication and delivery time for each item requiring off site fabrication.
  9. Start and completion dates for each mock up and sample including in place samples.
  10. The critical path of work.
- K. Contract Progress Schedule Reports: Submit reports including at least the following information:
1. The critical path of work and all work items on the critical path.
  2. Bar chart plot.
  3. Plot showing the content specified above.
  4. Monthly activity plots for each month.
  5. Minimum Three week “look ahead” plots, to be provided weekly for review at team meetings.
  6. “Executive Summary” indicating if on schedule or, if not on schedule, problem areas.
- L. Contract Progress Schedule Updates: Update as specified above.
1. Update whenever the Contract Time is revised by Change Order.
  2. Update whenever the critical path of work is affected.
  3. Update planned start and completion dates to actual start and complete dates.
- M. Recovery Plan: Construction Manager shall prepare and submit a “Recovery Plan” whenever the work is 10 calendar days or more behind schedule. Show how the project will be managed back to “on schedule” condition.
- N. Photographs: All Contractors shall document their work progress with digital photographs, to be provided digitally to the Owner and the Architect.
1. Photographer: Any competent person approved by the Owner and Architect.
  2. Digital Photographs: Minimum 3 million pixel, clearly legible, “jpeg” file images.
  3. Digital Submission: Upload photos weekly to project management software/online file storage. At project conclusion, provide CD of all photographs.
  4. Prints: Not required.

5. Lighting: Provide supplemental lighting as needed to provide clear, detailed images.
  6. Provide Weekly Construction Photographs:
    - a. Purpose: To document the progress of the work.
    - b. Quantity: At least 20 images per week.
    - c. Photo Identity: Give each photo a unique identity number.
    - d. Record: Date and time photo taken.
    - e. Log: Log each photo by number. Provide brief caption to describe view shown.
  7. Preconstruction Photographs: Record existing conditions with emphasis on nearby existing improvements indicated to remain. Clearly record existing damage.
- O. Daily Reports: Provide daily reports and submit to Owner/Owner’s Representative and Architect once per week. Include the following information:
1. Work in progress.
  2. Subcontractors on site with numbers of workers on site for each subcontractor.
  3. Deliveries received with copies of delivery receipts.
  4. Weather information including temperature, humidity, rainfall, snow.
  5. Interior environmental information including temperature and humidity.
  6. Unusual events including accidents.
  7. Visitors to site including authorities having jurisdiction.
  8. Communications and directions received from authorities having jurisdiction.
  9. Meetings with clear reference to meeting minutes.
- P. Long Lead Time Items: Time is of the essence in the Contract. Expedite and provide special management for “long lead time” items.
1. Identify and create a list of long lead time items as early as possible.
  2. Notify Owner and Architect of problematic long lead items which affect project completion.
  3. Expedite submittals related to long lead time items.



4. Place orders for long lead time items at the earliest possible time.
  5. Monitor production and delivery of long lead time items.
  6. Identify unexpected delays in long lead time items and notify Owner and Architect.
- R. On-Site Documents: Maintain the following documents on site and up-to-date:
1. Contract Documents (full size and color, as applicable)
  2. Modifications and changes to Contract Documents.
  3. Coordination drawings.
  4. Meeting notes for all types of meetings: progress, safety, pre-installation, special, and others.
  5. Progress schedules and related information.
  6. Project photographs.
  7. Daily reports.
  8. Submittal log and all submittals.

END SECTION 013000 KUA ADMINISTRATIVE REQUIREMENTS

**013300 KUA SPECIFICATIONS AND SUBMITTAL REQUIREMENTS**

1. SUMMARY

This section includes administrative and procedural requirements for submittals.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. FORMAT OF SPECIFICATION

Vermont Integrated Architecture, P.C. (VIA) has prepared these architectural specifications in totality. These specifications are intended to be easy to navigate yet more focused than a traditional specification, defining specific methods and materials as appropriate. Each specification section is organized as follows:

1. SUMMARY

Describes the products and processes applicable in this section.

2. SUBMITTAL PROCESS

Matrix indicates what type of submittal is required and any specific information or material required as part of the submittal. Blank matrix appears below:

Submittal	Req.	Specifics
Shop Drawings	X	
Product Cut Sheets	X	
Product Declarations	X	The Architect requests Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs) be requested of all subConstruction Managers in Divisions 3 – 15. If not available, the CM and associated subConstruction Managers must demonstrate that an adequate effort has been made to procure this information.
Product Samples	X	
Mock-ups	X	
Closeout submittals	X	

3. PRODUCTS

A list of all products represented in this specification section is listed here. Where possible, we try to identify specific manufacturers. In addition, material-specific information is also noted (i.e., dimension, tested values, finishes, colors, etc.)

4. EXECUTION & QUALITY CONTROL

Often this section includes a general description for installation and quality control. In addition, it includes specific required practices for each product listed in Section 3. These practices always consider the manufacturer’s recommended installation practices and often include measures above and beyond such practices. This section may also indicate any testing or inspection required to ensure quality and condition of material and installation.

**NOTE:** VIA welcomes input regarding the format and content of these specifications from Construction Managers, installers, and manufacturers. Such input may be directed to Andrea Murray at [andrea@vermontintegratedarchitecture.com](mailto:andrea@vermontintegratedarchitecture.com).

3. **SUBMITTAL PROCESSES & PROCEDURES**

Submittals are critical to the success of this project. Each specification section herein features the matrix shown above. Required submittals are clearly marked and specifics noted. By preparing and submitting a submittal, the Construction Manager confirms that the material submitted is in compliance with the contract documents. If submitting a substitution, Construction Manager and/or subcontractor must clearly identify the substitution on the coversheet and elsewhere as necessary in the submittal. You can expect the following for the review process:

**TIMING:** Submittals will be reviewed within 10 business days of receipt. If VIA is unable to achieve this turnaround, VIA will request an extension of this time from the Construction Manager. If a review is required in less than 10 days, it should be clearly noted in the submittal transmittal, and VIA will make every effort to meet the deadline requested.

The Construction Manager is required to review, check, and coordinate submittals prior to submission to the Architect, and specifically confirm that the submittal complies with the Contract Documents. The Construction Manager shall also confirm that work in the submittal is coordinated with adjacent and related work, including the work of other subcontractors.

**Re-submittal:** The Construction Manager shall clearly and boldly identify all revisions from the previous submittal. Revisions that are not clearly and identified will not be reviewed.

**Re-submittal Restriction:** If a submittal is rejected twice, the Construction Manager shall take special action to ensure approval of third submission. Further architect and engineer review and refinement will be at the expense of the Construction Manager per the architect and engineer's hourly rates for additional services.

**Rejected Submittals:** The Construction Manager must ensure that rejected submittals are not used at the site, for fabrication, or anywhere work is in progress.

**Construction Manager's Responsibility for Managing Submittal Process and Delays:** The Construction Manager shall manage the submittal process to achieve the Contract Completion Date, to maintain the Project Schedule, and to avoid delays. The Construction Manager is responsible for delays related to deficient submittals.

Incomplete and confusing submittals will be rejected without review, will require re-submittal, and will delay submittal approval.

**SUBMITTAL SCHEDULE & LOG:**

The Construction Manager shall:

1. Before the first submittal, create a Submittal Schedule for all submittals required.
2. Give each submittal item a unique submittal number and identity.
3. Indicate the date each submittal will be first submitted for review. Indicate the date each submittal requires approval to maintain project schedule.
4. Indicate actual dates of: first submittal to Architect, return to Construction Manager, and re-submittals, if any. Indicate Architect's response to each submittal.
5. Maintain Submittal Schedule and Record Log continuously up to date and accurate.
6. Allow the Architect to review the Submittal Schedule and Record Log at any time.

**SUBMISSION:** VIA requests that all submittals be accompanied by a transmittal that clearly identifies the specification section(s) to which it is responding. The transmittal shall also identify:

- a) everything that is included in the submission,
- b) specific items required by the specifications section and that are not included and intended to be submitted under separate cover,
- c) the name of the Construction Manager and sub-Construction Manager,
- d) a unique submittal number corresponding to specification division, and
- e) the date of submittal.

VIA requests that all shop drawings, product cut sheets, and warranty information be submitted in electronic format (Adobe pdf file preferred). Individual file sizes should not exceed 10 MB. See Section 011300 Administrative Requirements for requirements of project management software to manage the submittal process.

Drawings shall be to scale and not exceed 24" x 36" when printed as such.

Actual product samples and sample mock-ups shall be accompanied by a transmittal, and all samples shall be clearly labeled for reference.

Materials required by the specifications (i.e. product data/cut sheets, shop drawings, samples, close-out materials, etc.) should most typically be submitted together as a package, and not individually/piecemeal, to allow for comprehensive review and ease of tracking both during construction and for the owner's O&M documents.

At each weekly meeting, Construction Manager to provide a 1-2 week look-ahead submittal update indicating materials Construction Manager anticipates ready for submission and review by the Architect.

If the Construction Manager provides multiple concurrent submittals to the Architect, the Architect retains the right to request a prioritization of submittal review.

**SUBSTITUTIONS:**

See specification Section 012500 for Substitution Procedures.

**4. REVIEW ACTIONS**

After review, VIA will return submittals marked as follows:

1. **Reviewed (no comment):** Work covered by submittal may proceed provided it complies with requirements of Contract Documents. Final acceptance will depend upon that compliance. The term "Reviewed" shall only indicate that there is no exception taken to the submittal.

2. **Reviewed (see comments):** Work covered by submittal may proceed provided it complies with notations and corrections on submittal and requirements of Contract Documents. Final acceptance will depend upon that compliance.

3. **Reviewed (revise and resubmit):** Do not proceed with work covered by submittal including purchasing, fabricating, and delivering. Revise or prepare new submittal in accordance with notations and resubmit.

**5. DISTRIBUTION:**

Provide and distribute copies of Architect-reviewed submittals to subcontractors, suppliers, manufacturers, fabricators, and other parties needing copies.

Upon receipt of reviewed submittals from the Architect, each Construction Manager shall also provide digital copies of the reviewed submittals to all other prime Construction Managers on the project, for coordination purposes.

**6. REQUESTS FOR INFORMATION:**

"Request for Information" and "Request for Interpretation" are the same. RFI is the acronym for these inquiries. All RFIs must be submitted in a timely manner and with clear communication.

Construction Manager's RFIs are intended for use after Bidding and Contract Award: During bidding and pricing, the Construction Manager is required to study and understand the Contract Documents, to compare the Contract Documents with each other, and to report or submit questions on errors, inconsistencies, and ambiguities discovered.

By submitting a bid or executing the Contract for Construction, the Construction Manager affirms that the Construction Manager understands the Contract Documents. Consequently, there should be few RFIs after bidding and after Contract award.

The Construction Manager shall avoid unreasonable RFIs. "Unreasonable RFIs" are RFIs which can be answered by information already available to the Construction Manager. The Architect may request payment from the Owner for costs associated with responding to excessive, unreasonable RFIs. The Owner may deduct excessive, unreasonable RFI costs from payments due to the Construction Manager.

The Construction Manager shall:

1. Issue all RFIs. RFIs will not be accepted from trade bidders, subcontractors, or suppliers.
2. Issue the RFI only after confirming the information is not already available.
3. Use a separate RFI form for each topic, question, and request.
4. Sequentially number each RFI.
5. Maintain a log of all RFIs including topic, date issued, date response received.
6. Not use RFIs as a "Request for Substitution."

VIA recognizes that a timely flow of information is important to a successful construction process. VIA will attempt to respond to RFIs in a timely manner to keep the construction process moving. VIA shall:

1. Respond to RFIs in writing in no less than 10 days.
2. If a Construction Manager requests an expedited response, VIA will evaluate that request in relation to the associated work and make every attempt to meet the request.
3. Not all RFIs can be requested as "expedited response".
4. VIA response to an RFI shall not be interpreted as a "Construction Change Directive". If a Construction Manager believes that an RFI response requires a contract change, that request for contract change must be noted immediately.

7. QUALITY CONTROL

Quality Assurance:

Activities, actions, and procedures performed before and during execution of the work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements is the responsibility of the individual Construction Managers.

Quality Control:

Tests, inspections, procedures, and related actions during and after execution of the work to evaluate that actual products incorporated into the work and completed construction are the responsibility of the Construction Manager. In addition, the Construction Manager will regularly take photographs which demonstrate quality of workmanship.

Recommended Standards - Compliance:

Standards referenced in the Contract Documents are part of the Contract Documents and have the same force and effect as if bound into the Contract Documents.

1. Governing Date and Edition: Unless specified otherwise, the latest date, edition, and revision issued by the bid due date or, if no bids received, by the date of the Contract.
2. Copies: Obtain copies directly from the publisher. Keep one copy of each reference standard filed at the job site by specification section number[s] in which the reference is made.
3. Conflicts: Where reference standards conflict with other referenced standards or with the Contract Documents or with requirements of authorities having jurisdiction, contact Architect for clarification.

All products shall be stored, protected, and installed in compliance with manufacturer's recommendations. In addition, material warranties shall be consulted by Construction Managers to ensure installation practices do not, in any way, void a manufacturer's or installer's warranty. Any discrepancies shall be brought to the attention of the Architect during the submittal review process.

END SECTION 013300 KUA SPECIFICATIONS AND SUBMITTAL REQUIREMENTS

**014000 KUA QUALITY REQUIREMENTS**

1. SUMMARY

This section includes administrative and procedural requirements for managing project quality.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		

3.1 SECTION INCLUDES: General quality requirements

- A. Codes and Regulations: Comply with all applicable laws, building codes, ordinances, regulations, and requirements of all authorities having jurisdiction.
  - 1. Part of Contract Documents: Laws, building codes, ordinances, regulations, and requirements of all authorities having jurisdiction are an integral part of the Contract Documents.
  - 2. Governing Date and Edition: Unless specified otherwise, the latest date, edition, and revision adopted by the bid due date or, if no bids received, by the date of the Contract.
  - 3. Submit Copies: Submit to Owner and Architect copies of all permits, licenses, certifications, notices, judgments, and all other communications from authorities having jurisdiction.
- B. Abbreviations: Abbreviations used typically have well known meanings. Ask the Architect for clarification when necessary.
  - 1. Trade Association Abbreviations: Consult the “Encyclopedia of Associations”.
- C. Reference Standards: Standards referenced in the Contract Documents are part of the Contract Documents and have the same force and effect as if bound into the Contract Documents.
  - 1. Governing Date and Edition: Unless specified otherwise, the latest date, edition, and revision issued by the bid due date or, if no bids received, by the date of the Contract.



2. Copies: Digital reference of standards is acceptable.
  3. Conflicts: Where reference standards conflict with other referenced standards or with the Contract Documents or with requirements of authorities having jurisdiction, the most restrictive requirement is required by the Contract Documents.
  4. Requirements and Recommendations: Comply with all requirements and recommendations included in reference standards.
- D. Coordination Meetings and Pre-Installation Conferences (See 013000 Administrative Requirements). These conferences and meetings are essential for establishing quality control expectations across disciplines. At these meetings/conferences, the following, at minimum, will occur:
1. Establish expectations for subcontractor responsibilities;
  2. Review products, installation, mock-ups, etc.;
  3. Confirm sequencing, conditions, etc. for installation;
  4. Address all installation questions and concerns;
- E. Definitions:
1. Provide: Means furnish and install.
  2. Furnish: Means supply and deliver to the site, complete with all necessary components.
  3. Install: Means unloading, storing, handling, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, placing in service, cleaning, protecting, and similar operations to make ready for intended use.
  4. Final Connection: Means placing in service, connecting to utilities and services, and make operational and ready for intended use.
  5. Indicated, Shown: Is a reference to other Contract Documents.
  6. Approved: Means “approved by Architect” and is limited by the Conditions of the Contract.
  7. Day: Means calendar day, unless “business day” or “working day” is specified.
  8. Match: Means identical in visual characteristics, quality, construction, material, and other features and characteristics. For appearance, “match” means as judged by the Architect.
  9. Construction Manager: Defined in the Owner-Construction Manager AIA Agreement.
  10. Reference Products, Basis of Design: Is a product used to help the reader understand a specification. Since the specification may require options, custom features, and other special characteristics, the “Reference Products” and “Basis of Design” is not the specification and does not supersede the specification. “Reference Products” and “Basis of Design” are not proprietary specifications and are not intended to restrict competition, unless identified as “proprietary”.
  11. Authorities Having Jurisdiction (AHJ): Means all governing agencies, organizations, bodies, and authorities which have authority or jurisdiction over aspects of the Contract.
  12. Proprietary Products: Are specific items which shall be provided without substitution or equal. Procurement for this project is intended to be an open and fair process, which allows for substitutions as approved equals. The Construction Manager is

welcome to submit substitutions for any product indicate in these documents. See 012500 Substitution Procedures.

13. Exposed: Means visible. Interiors of closets, mechanical/electrical rooms, and similar spaces are visible and are exposed.
  14. Concealed: Means not visible. Interiors of chases, shafts, and crawl spaces are concealed. Areas above continuous ceilings are concealed. Conditions above lay in ceilings are not “concealed” or “unknown” for the purposes of claims.
  15. Shall: Is an auxiliary verb which expresses obligation and necessity.
- E. Tests and Inspections: Construction Managers shall schedule and coordinate all tests and inspections by authorities having jurisdiction and testing agencies employed or paid by the Owner or Construction Manager.
1. Test and Inspection Schedule and Record: Create, submit, and maintain a Test and Inspection Schedule and Record. Give each test and inspection a unique identifier related to specification section number. Schedule testing and inspection dates. Record and file test results and reports. Submit Test and Inspection Schedule and Record at least monthly and when requested by Owner or Architect.
  2. Test and Inspection Limitations: Since all Contract requirements are not tested or inspected, successful test and inspection does not mean the work is acceptable. Work with satisfactory tests and inspections may be rejected if non-conforming with other Contract requirements.
  3. Tests and Inspections by Owner: Individual specification sections may require tests and inspections by Owner. Cooperate with the Owner and testing agencies employed by the Owner. Permit free access to all work at all times including off site during manufacture and fabrication. Schedule and coordinate all tests and inspections by Owner. For onsite sampling, tests, and inspections, provide incidental labor, safe access, utility services, and on-site storage.
  4. Advance Notice for Tests and Inspections by Owner: Maintain the approved Test and Inspection Schedule and Record. Make request to the Owner at least 5 working days in advance of all tests and inspections by Owner.
  5. Tests and Inspections by Construction Manager: Provide all tests and inspections assigned to the Construction Manager in the Contract Documents. Employ independent testing agencies preapproved by the Owner, Architect, and authorities having jurisdiction.
  6. Advance Notice for Tests and Inspections by Construction Manager: Maintain the approved Test and Inspection Schedule and Record. Notify the Owner and Architect at least 48 hours in advance of all tests and inspections by Construction Manager.
  7. Cost of Failed Tests and Inspections: Pay all costs related to failed tests and inspections.

8. **Manufacturer’s Standard Test Data and Information:** Submit complete test reports and not only test results or test summaries. Tests and inspections by other than independent testing agencies may be rejected as unacceptable or biased. All tests and inspections shall be less than two years old and certified by the manufacturer to be applicable to current production.
  
- F. **Discrepancies in Documentation:** Any discrepancies in the design documentation shall be brought to the attention of the architect prior to purchase and/or installation of any product or material involved in the discrepancy. Proceeding with construction where a discrepancy or conflict occurs without contacting the architect shall be done at the risk/cost of the Construction Manager.
  
- G. **Sustainability, Systems, and Building Performance:** See Section 3.2.A.3 of specification section 01100 Summary for information regarding sustainability goals and priorities as they relate to building and system design.
  1. Performance metrics and standards have been described in the individual specification sections and establish quality control requirements for specific building elements.
  2. Building Envelope and MEP Commission agents have be retained by the owner to review, test, and report on the quality of installed work.
  3. EPDs and HPDs are noted as required for most specification sections. See matrix in Section 2 of individual specification sections. If an EPD or HPD is not available for a product, contractor/sub-contractor is required to provide documentation of the request made to the vendor/manufacturer including the vendor/manufacturer’s response that the requested documentation is not available. Email documentation is sufficient to meet this requirement and is to be included with the submittal for team review and record.

END SECTION 014000 KUA QUALITY REQUIREMENTS

**014339 KUA MOCK UPS**

1. SUMMARY

This section includes administrative and procedural requirements for mock ups.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		Per related systems
Product Cut Sheets		-
Product Samples		
Mock-ups	x	
Closeout submittals		

3.1 SECTION INCLUDES: General requirements for mock ups.

A. Mock Up General Requirements:

1. Intent 1: To permit Owner and Architect’s review and approval of assemblies prior to full implementation or production.
2. Intent 2: Approved mock ups serve as examples of acceptable work.
3. Intent 3: To allow subcontractors to establish coordination and quality control efforts for a specific project component.
4. Schedule: Construct mock ups at the earliest possible time and before ordering production quantities of materials. (Note in-site mocks are acceptable, however, some advance mock-ups may be beneficial for schedule and sequencing. For example, ordering a window out of sequence to begin mock-up reviews and prior to full release of window package could be beneficial.)
5. Materials: Provide actual materials to be used in the Project including actual finishes and colors. Do not provide simulations, unless preapproved by Architect.
6. Locations: Window location as mutually agreed by Architect, Owner and Construction Manager.
7. Protect: Protect approved mock ups from damage and modification.
8. Disposal: Mock-ups may be left as part of the work, if approved by the Architect and Owner. If not approved to remain as part of the work, mock-ups shall be offered to

the Owner, Architect, and Subcontractors. If none would like to keep the mock-up(s), they shall be demolished, removed, and disposed of.

**B. Required Mock Ups:**

1. Size: As necessary.
2. Scope: A complete assembly sufficient to judge for acceptability.
3. Locations – as noted in individual specification sections, including but not limited to:
  - a. Complete exterior wall assemblies including windows, control layers, siding, trim, venting, finishes, etc.

END SECTION 014339 KUA MOCK UPS

**014400 KUA ENGINEERING BY CONSTRUCTION MANAGER**

1. SUMMARY

This section includes administrative and procedural requirements for engineering provided by the Construction Manager.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	As required for each instance
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		

3.0 INSTANCES: Engineering by Construction Manager (delegated design) is noted in individual specification sections and in on-drawing specifications. Delegated Design is required for the fire protection system and for other areas of the project as noted in the Contract Documents.

3.1 REQUIREMENTS: General requirements for engineering by Construction Manager required in individual specification sections.

- A. Engineer’s Qualifications: A Vermont State-Registered Professional Engineer employed by the Construction Manager. The engineer shall be registered in the discipline for which the engineering is required.
- B. Professional Liability, Errors and Omissions Insurance for Design Professionals Employed by the Construction Manager: The Construction Manager’s Professional Engineers shall provide the same insurance coverage and limits required by the Contract, except insurance shall cover design and engineering work.
- C. Engineering Requirements: Meet design intent and performance, appearance, minimum, and other requirements indicated in the Contract Documents.
  - 1. Minimum Requirements: Meet specified minimum requirements [example: specified minimum metal gage] even if the Construction Manager’s engineer determines that a lower requirement [example: thinner metal gage] will satisfy indicated Contract requirements.
- D. Engineer’s Responsibilities: The Professional Engineer employed by the Construction Manager shall:

1. Be solely professionally responsible for the work.
  2. Calculate, design, engineer, and document the work.
  3. Prepare, professionally seal, sign, and submit calculations, shop fabrication drawings, erection and installation drawings, and other documents needed.
  4. Meet requirements of authorities having jurisdiction including applicable Codes.
  5. Meet requirements specified in the Contract Documents including visual requirements.
  6. Meet industry standards, unless higher performance is specified in the Contract Documents.
- E. Substitutions: All work engineered by the Construction Manager that deviates from Contract requirements shall comply with Section 012500 Substitution Procedures.
- F. Limitations of Architect's Review: Architect's (or Architect's Consultant's) review of submittals related to work engineered by Construction Manager shall be limited to review of visible appearance and design intent only.
- G. Design Loads: See Structural Basis of Design for minimum design loads. Design loads shall never be less than minimum design loads per applicable building codes.

END SECTION 014400 KUA ENGINEERING BY CONSTRUCTION MANAGER

**014517 KUA FIELD TESTING OF EXTERIOR ASSEMBLIES**

1. SUMMARY

This section includes administrative and procedural requirements for field testing.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements

See Section 019119 Exterior Envelope Commissioning.

See Erosion & Sediment Control Plan notes for requirements regarding SWPP (Storm Water Pollution Prevention Plan) inspections.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		-
Mock-ups		<b><i>As required by individual spec sections for testing, per specs.</i></b>
Closeout submittals		<b><i>Progress testing reports, and final compliance reports</i></b>

3. REQUIREMENTS

Requirements for field testing and inspection of exterior assemblies.

- A. Owner’s Responsibilities: The Owner may employ a testing agency to field test exterior assemblies for air and water leakage and thermal performance.
  - i. Testing Agency Qualifications: Independent from Owner, Architect, and Construction Manager, and accredited by International Accreditation Service Inc. or American Association for Laboratory Accreditation
  - ii. Testing Agency Selection: The Owner may comply with ASTM E699 Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components.
  
- B. Intent: Owner’s field testing is intended to confirm performance of actual, field installed assemblies.
  - i. Manufacturer’s product test information is not a substitute for field testing of installed work.
  - ii. Owner’s testing is intended for the Owner’s benefit.
  - iii. Owner is not obligated to perform tests for the Construction Manager’s benefit.
  
- C. Field Test Methods: Owner’s option will include, at minimum:



- i. Special Inspections as required by structural contract documents.
  - ii. Soils compaction testing.
  - iii. Concrete testing.
  - iv. Envelope testing
    - a. **Testing of mock-ups will be performed and are to be coordinated with Architect.**
    - b. **First Instance testing- fog tests and visual inspections (3 visits min) typical test areas:**
      - 1. **Wall to roof assemblies**
      - 2. **Window and door openings**
      - 3. **Wall to foundation assemblies**
      - 4. **New addition to existing at walls and roof**
      - 5. **Typical penetrations**
      - 6. **Overhangs and awnings**
    - c. **Whole building air-tightness testing**
      - 1. **progress (prior to concealment) and final compliance**
    - d. **As noted in individual specification sections, and including but not limited to:**
      - 1. **Storefronts/Curtain Walls/Windows**
        - a. **ASTM E1105/AAMA503 (Water penetration testing, AAMA 502 for window units)**
      - 2. **General Air Control Layer Systems**
        - a. **ASTM E1186 Air Leakage testing using theatrical fog testing and/or infrared imaging**
        - b. **ASTM E3158 Compliance Blower Door Testing**
    - e. **All testing to be coordinated on project schedule with milestones noted for team coordination.**
- D. Reports: The Testing Agency will provide written reports for all tests performed including:
- i. Each test location, test date and time.
  - ii. All test procedures including deviations, if any, from published test methods.
  - iii. Test results.
  - iv. Identification of failures, if any.
  - v. Opinions about cause of failures, if any
  - vi. Suggestions for remedial work, if any failures.
- E. Acceptance: The Contract requires installed work to meet Contract requirements. **See individual specifications sections for testing targets for whole building air-tightness, water infiltration, window testing, etc.**
- i. No increase in specified air and water leakage limits is permitted.
  - ii. Field test pressures may be lower than Contract specified performance test pressures, but not less than 6.24 pounds per square foot.
  - iii. Any uncontrolled water leakage into the interior is a failure. From AAMA 503-03, 4.8.1: "Controlled water leakage is defined as any water that is contained in an area with

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provisions to drain back to the exterior, or the collection of up to 14 grams [0.5 ounce] of water collected in the 15 minute test period on top of an interior horizontal frame surface that does not spill onto adjacent finishes or materials.”.

- F. Product and Assembly Warranties: Because Owner’s field testing is non destructive and will not impair performance of exterior assemblies, product and assembly warranties shall not be revoked or modified because of Owner’s testing.

4. SCOPE OF TESTS AND TEST SEQUENCE:

- A. Tests of Completed Air Barrier System for Air and Water Leakage: Test actual wall construction [not just mock up] after air barrier system, flashings built into walls, and all glazed assemblies located in test areas are complete, but before any covering construction is installed.
- i. Test Locations: Owner’s option with Architect input.
- B. Tests of Completed Wall for Air and Water Leakage: Test actual wall construction [not mock up] after entire wall assembly including sealants and weeps in test areas are complete.
- i. Test Locations: Owner’s option with Architect input.

5. PROCEDURE FOR EACH FAILED TEST:

- A. The Owner, Architect, Testing Agency, and Construction Manager shall determine the cause[s] of failure[s].
- B. Remedial work shall be provided.
- C. Retesting shall be done at the original failed test location.
- D. Procedure shall be repeated until test results are acceptable.

6. CONSTRUCTION MANAGER’S RESPONSIBILITIES FOR FIELD TESTING OF EXTERIOR ASSEMBLIES:

- A. Cooperate with the Owner and the Owner’s testing agency.
- B. Fully complete construction of test locations at the earliest possible time.
- i. Allow joint sealants to cure for at least 10 days prior to testing.
- C. Notify Owner 10 working days prior to dates test areas will be ready for test.
- D. Provide safe access to both interior and exterior sides of test areas.
- i. As needed, provide scaffolding, staging, and man-lift.
- E. Provide clear, unobstructed interior space at each test area.
- F. Provide exposed, open interiors at test areas with no visual or access obstructions.
- G. Provide water for testing. (3/4” hose connection within 300’ of the test location)
- H. Provide 120 Volts AC, 30 Amps and 220 Volts AC, 30 Amps electric power for fan motors.
- I. Provide temporary heat, if schedule requires, for window testing.**
- J. Construction Manager’s Responsibilities for Test Chamber Construction: None.

- K. Construction Manager’s Responsibilities for Modifications of Exterior Assemblies at Test Locations: To provide more accurate test results by reducing extraneous air and water, modify exterior assemblies at each test location as directed by Owner’s testing agency.
- i. Required modifications will not damage exterior assemblies.
  - ii. Required modifications will not impair performance of exterior assemblies.
  - iii. Required modifications may include, without limitation, foamed in place foam closure of mullion ends, additional joint sealants, and other modifications.

7. OWNER’S INSPECTION RESPONSIBILITIES FOR EXTERIOR WALL ASSEMBLIES:

The Owner may employ a testing agency to inspect exterior wall assemblies.

- A. Testing Agency Qualifications: Independent from Owner, Architect, and Construction Manager, **and qualified/certified to perform the required tests to meet listed standards.**
- B. Testing Agency Selection: The Owner may comply with ASTM E699 Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components.
- C. Testing Agency Services Required:
- i. Attend preconstruction and pre-installation meetings.
  - ii. Provide intermittent inspection of exterior wall construction.
  - iii. Provide continuous, full-time inspection of all field tests.
  - iv. **Review flashings, sealants, sill pans, and other exterior wall work prior to concealment and provide feedback/commentary for quality assurance.** (A representative random sampling of locations to be reviewed and confirmed as acceptable performance.)
  - v. Identify deviations from the Contract requirements.
  - vi. Identify problems, deficiencies, and failures.
  - vii. Determine causes of problems, deficiencies, and failures.
  - viii. Recommend remediation of problems, deficiencies, and failures.
  - ix. Consult with and advise Architect about exterior wall details, performance, and construction.
  - x. Provide a “punch list” of incomplete and non conforming work.
  - xi. Certify that work was completed in compliance with Contract Requirements, except for deviations identified by the Inspector.

END SECTION 014517 KUA FIELD TESTING OF EXTERIOR ASSEMBLIES

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**014610 KUA REMEDIAL WORK TO CORRECT ERRORS**

1. SUMMARY

This section includes administrative and procedural requirements for remedial work to correct errors.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		

3. GENERAL REQUIREMENTS FOR REMEDIAL WORK TO CORRECT ERRORS

A. Applicability: Remedial work includes cutting and patching associated with:

- i. Defective, non-conforming, ill-timed and improperly fitting work.
- ii. Removing samples of installed work for testing, inspection, and verification.
- iii. Patching of sample removal locations.

B. Submittals: For each patching material and product, submit manufacturer’s data including instructions, recommendations, and restrictions.

C. General Requirements for Remedial Work:

- i. Cutting: Minimize cutting to amount required for remedial work, and cut in such a manner as to reduce visual impact of cutting work.
- ii. Patching Materials: Match materials to be cut and patched in quality, durability, and appearance.
- iii. Craft: Employ highly skilled trade workers for all patching work.
- iv. Subcontractors: Shall coordinate their work with the Construction Manager to avoid remedial work.
- v. Make durable, permanent patches.
- vi. Comply with specified tolerances for similar new work.
- vii. Match the visual quality and character of adjacent un-patched work in good condition.
- viii. Create true, even surfaces with uniform, continuous appearance.

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- ix. Extend patched area onto adjoining un-patched areas to eliminate visible evidence of patching.
- x. Repaint entire assemblies, not only the patched area, to nearest major change of plane.
- xi. Obtain Architect's visual approval of each patch.
- xii. Visible evidence of patching is cause for rejection and replacement.

END SECTION 014610 KUA REMEDIAL WORK TO CORRECT ERRORS

**015000 KUA TEMPORARY FACILITIES AND CONTROLS**

1. SUMMARY

This section includes requirements for controlling dust, dirt, and noise as well as environmental protections during construction.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	-
Product Cut Sheets	NA	-
Product Samples	NA	
Mock-ups	NA	
Closeout submittals	NA	
Other	X	Temporary Facility & Logistics Planning Plans/Material

3.1 SECTION INCLUDES: General requirements for temporary facilities and controls.

- A. Scope of Temporary Facilities and Controls: This section does not limit or restrict the scope of temporary facilities and controls required.
  - i. The Construction Manager is solely responsible for means, methods, and techniques used to complete the work of the Contract, including all temporary facilities and controls.
  - ii. Remove and dispose of all temporary facilities and controls when they are no longer needed.
  - iii. Relocate temporary facilities and controls as needed to accommodate phased work, if any.
  - iv. Relocate any temporary facilities if they interfere with on-going KUA operations unless otherwise approved by the Owner and the Owner’s Representative.
  
- B. Permits and Fees: The Construction Manager will obtain and pay for all permits, fees, and charges related to temporary work. The Owner (with assistance from the Architect and Civil Engineer) is responsible for obtaining the general building permit from the Town of Plainfield, the local zoning permit, Alteration of Terrain permit, and Department of Transportation permit. All other required permits are the responsibility of the Construction Manager and appropriate subcontractors.
  
- C. Authorities Having Jurisdiction (AHJ): Comply with all requirements of authorities having jurisdiction including, but not limited to, the following:

**Town of Plainfield**

Fire Chief – Bill Taylor

Town Building Inspector - David Lersch

- D. Temporary Water: Temporary water is available on site. This may be maintained or tapped onto for the duration of the project.
- E. Temporary Electric Power and Lighting: The Electrical subcontractor shall work with the Construction Manager and the Owner to set a temporary meter for the project to provide and maintain safe, Code complying, temporary electric service throughout the Contract, including temporary lighting and electric power for temporary offices. Provide all utility connections and make all arrangements for this service. Provide conductors, panel boards, circuit breakers, outlets, light fixtures, lamps, and all other items needed.
- i. Construction Manager will coordinate the location of this meter with the Owner's Representative.
  - ii. Construction Manager provides temporary electric power and lighting system.
  - iii. Owner pays for power used.
  - iv. Lighting: Provide as needed for work and to ensure safety and security.
  - v. Lighting for Finish Work: Sufficient light levels to install finishes.
- F. Temporary Heat: Provide and maintain safe, Code complying, temporary heating as required for the installation of finishes at the later portion of the Contract. Use of the building HVAC systems for temporary heat is prohibited until after sanding of sheetrock and any other dust-creating construction activities are complete. Provide all utility connections and make all arrangements for this service. Provide all fuel, equipment, distribution, controls, and other items needed.
- i. Fuel use is required to be metered by the Construction Manager, and reported to the Owner.
  - ii. Construction Manager provides temporary heat system:
  - iii. Construction Manager pays for heat and fuel: Electric heat is not permitted.
  - iv. Minimum Ambient Temperature: 40 degrees F, unless higher required by manufacturers.
  - v. Minimum Substrate Temperature: 40 degrees F, unless higher required by manufacturers.
  - vi. Finish Work: Higher ambient and substrate temperatures typically required by manufacturers.
  - vii. Relative Humidity: Maximum 50 percent during temporary heating.
  - viii. Temperature and Humidity Records: Record in daily reports.

- ix. Restrictions: Prevent damage from soot, smoke, water vapor, and fire. Do not use heating systems which interfere with curing of mortar and grout.
  - x. Heating After Substantial Completion: Responsibility of the Owner.
- G. Permanent Heating System: After the permanent heating system is operational for any reason including, without limitation, temporary heating for non-dust creating finishes, testing, and balancing, the following conditions and restrictions apply:
- i. Maintain the system in “like new” condition.
  - ii. Install all permanent filters specified.
  - iii. Provide additional temporary filters at all system openings to prevent contamination.
  - iv. Change filters at least weekly and more frequently as needed to prevent contamination and deterioration. Comply with Section 018120 “Air Quality” including requirements for new filters at Substantial Completion. See Mechanical Specifications for flush-out requirements.
  - v. Completely inspect, service, and, as needed, restore the entire system immediately prior to Substantial Completion.
  - vi. Temporary operation of the permanent heating system does not mean acceptance by Owner.
  - vii. Warranties start as specified in Section 017836 “Warranties” and not upon first temporary use.
  - viii. For heating systems specified to have chemical treatment, do not operate systems without chemical treatment fully installed and operational.
- H. Temporary Toilets: Provide and maintain clean, well-supplied portable toilet facilities for all workers throughout the Contract.
- i. Comply with requirements of authorities having jurisdiction.
  - ii. Do not use permanent facilities within the building.
  - iii. Location: Where preapproved by Owner.
- I. Temporary Building Enclosures: See 011200 Multiple Contract Summary. Design and provide temporary enclosures to protect the building interior from weather and to control access to building interior.
- i. Do not obstruct life safety egress or ADA Accessibility to existing buildings in use.
  - ii. Provide weather and wind resistant temporary enclosures.
  - iii. Provide temporary enclosures appropriate for their intended service and duration.
  - iv. Maintain ventilation to allow the building interior to dry.
- J. Construction Manager’s Field Offices: Construction Manager's option subject to the following conditions and constraints:
- i. A field office is required for the General Construction Contract. A field office is optional for the Plumbing Contractor, the Mechanical/HVAC Contractor, and the Electrical Contractor.



- ii. Power, telephone, answering machine, e-mail, and copier services and equipment are required.
  - iii. Project meeting space large enough to accommodate the Construction Manager staff, the Owner, the Owner's Project Manager, the Architect, staff of the other prime Contractors, and occasional guests. A meeting table and chairs are required. Per COVID requirements, meetings may occur outside as weather permits. The Owner may agree to provide space for an on-site meetings if the job trailer is not sufficient.
  - iv. Maintain Construction Manager's field office throughout the Contract until substantial completion.
  - v. Confine Construction Manager's field office to location and area preapproved by Owner and Civil Engineer.
  - vi. Electrical Contractor is responsible for providing a code-compliant power connection to the field office.
  - vii. Data Connection: The Construction Manager is responsible for providing a wired data connection for email and access to electronic communication, and data transfer required for managing a modern construction project – provide a dedicated data connection for the construction field office, including a wi-fi portal for use by design team, Owner and sub-contractors. Provide access for Owner's Project Manager to connect to data system.
  - viii. Telephone: Use cell phone or install a separate phone service if the above data connection does not come with phone service capability.
- K. Equipment and Tools: Provide and maintain all equipment and tools required to safely complete the Contract.
- L. Material Handling, Hoists, Rigging, Protection: Provide all equipment and work required.
- M. Safe Access: Provide safe access to all parts of the work for construction, review, inspection, and observation.
- N. Permanent Stairs: Erect permanent stairs as soon as practical. Do not permit use of permanent stairs until stairs are completely erected, ready to accept design loads, and fitted with temporary protective treads, risers, handrails, guardrails, and shaft protection.
- O. Scaffolding and Staging: Provide all scaffolding and staging needed to safely execute the Contract. Protect scaffolding and staging from unauthorized use.
- i. Engineering Responsibility: Engineer to comply with OSHA requirements and requirements of authorities having jurisdiction.
- P. Access, Traffic Control, and Parking: Limit site traffic to access and egress points approved by the Owner, Architect, and authorities having jurisdiction.
- i. Flaggers: Control traffic and provide flag persons to ensure safety.
  - ii. PARKING: The construction Manager will work with the Owner's representatives to define an area for construction worker parking. The construction manager will communicate to and provide signage as necessary to define these areas for workers.

- iii. Emergency Vehicles: Maintain clear access for emergency vehicles. Do not obstruct hydrants.
  - iv. Police Details: Provide police details required by authorities having jurisdiction.
- Q. Trucking: Comply with authorities having jurisdiction.
- i. Restrict truck traffic to approved truck routes.
  - ii. Schedule truck traffic outside of normal, operational hours.
  - iii. Comply with truck engine idling laws and ordinances.
  - iv. Do not over load trucks.
  - v. Cover all open trucks entering and leaving the site. Do not spill load on public way.
  - vi. Wash truck tires and wheels prior to leaving the site. Do not soil the public way.
- R. Pedestrian Traffic: Comply with authorities having jurisdiction.
- i. Maintain safe pedestrian traffic around the work site.
  - ii. Provide barriers to protect pedestrian traffic from vehicular traffic.
- S. Temporary Fencing: Construction Manager to provide temporary fencing and locked gates to protect the work, protect materials, prevent injury, and to control access.
- i. Scope and Extent: As shown or, if not shown, continuously enclose the entire work limits.
  - ii. Fence: Structurally stable, plumb, and aligned galvanized steel chain link fence.
    - a. Provide a construction screen (printed) <https://www.fencescreen.com/Logo-on-Fence-Screen/Direct-Print.aspx> (or other) at chain link fence along Main Street. Coordinate the design with the architect and owner.
    - b. Vision Screen: If visuals are screened, please provide “windows” for viewing.
  - iii. Height: As shown or, if not shown, minimum 6 feet above grade.
  - iv. Appearance: A high quality, neat, permanent appearance is important and required.
  - v. Gates: Provide at all entrances and exits.
  - vi. Locks: Use padlocks. Provide two sets of keys to Owner.
- T. Water Control, Pumping and Drainage: See Civil Drawings and Specifications. Effectively control water to prevent erosion, siltation, and damage to the work of the Contract, the Project site, and other properties. Control and dispose of standing water and running water regardless of its source.
- U. Erosion Control: See Civil Drawings and Specifications. Control erosion and siltation of drainage systems and wetlands. Provide and maintain effective temporary controls including, without

limitation, filter fabric fences, staked hay bales, drainage mats, and other controls. See civil documentation.

- V. Snow and Ice Control: Construction Manager to control and remove all snow and ice which interferes with work or safety. Do not obstruct public ways. Do not stockpile outside the work limits. Do not obstruct emergency access or egress. Use the minimum necessary snow melt chemicals. Coordinate these efforts with KUA facilities personnel.
- W. Security: Construction Manager to be primarily responsible for security of and access to all areas under the Construction Manager's control.
- X. ADA Access to Existing Building: If Kilton dorm remains occupied during construction, the Construction Manager shall provide an accessible pathway at the main building entrance for the duration of the construction.

### 3.2 FIRE PROTECTION:

- A. Fire Prevention and Protection: Take precautions to prevent fire.
  - i. Standard: NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
  - ii. Inspections: Obtain inspections by fire department and Owner's and Construction Manager's insurance underwriters. Abide by their instructions and recommendations.
  - iii. Information to Owner and Architect: Notify Owner and Owner's Project Manager prior to all fire and safety inspections. Submit copies of all inspection communications and reports.
  - iv. Permits: Obtain permits as required by authorities having jurisdiction.
  - v. Burning: Intentional burning of debris and waste on site is prohibited.
  - vi. Equipment Restrictions: Use spark arrestors on combustion equipment.
  - vii. Storage: Store flammable materials in UL listed safety cabinets or containers and in fire resistant locations preapproved by authorities having jurisdiction.
  - viii. Welding and Torch Cutting: Protect combustible materials from ignition.
  - ix. Compressed Gases: Securely restrain compressed gas tanks. Prevent falling. Protect from high temperatures, direct sunlight, and combustion.
  - x. Welding Equipment: Employ competent, experienced persons to install, connect, inspect, maintain, and operate welding equipment.
  - xi. Smoking: Smoking is prohibited within 50 feet of flammable materials and hazardous areas.
- B. Fire Watches: Provide fire watches for at least 30 minutes after hot work is stopped or interrupted.
  - i. Hot Work Definition: Includes soldering, welding, torching, and work which could ignite fires.
  - ii. When: During coffee breaks, lunch, end of day, and whenever work is stopped or interrupted.

- iii. Reference Standard: Comply with NFPA 51B “Standard for Fire Prevention During Welding, Cutting, and Other Hot Work”.
- C. Fire Fighting: Maintain continuous access to hydrants, stand pipes, and other equipment.
- i. Temporary Fire Extinguishers: Construction Manager to provide at least one for each 5,000 square feet.
  - ii. Hot Work: Provide portable fire extinguishers immediately at hand during hot work.
  - iii. Permanent Fire Protection Systems: Make systems operational at the earliest possible time.
- 3.3 HOUSE KEEPING, CLEANING, WASTE MANAGEMENT: Maintain all areas within the work limits and all areas under the Construction Manager's control clean and orderly at all times. Also see section 015240 Construction Waste Management. Each Contractor is responsible for dust control, cleaning during and after their work as well as managing the waste streams created by their work.
- A. Daily Cleaning: Clean up waste and debris each day.
- B. Dumpsters: Provide and pay for all dumpsters and waste removal. See Construction Waste Management requirements herein.
- i. Confine and contain waste and debris in steel dumpsters.
  - ii. Locate dumpsters where preapproved by Owner.
  - iii. Permits: Obtain all permits required by authorities having jurisdiction.
- C. Trash Barrels and Containers: Use steel containers with tightly fitting lids.
- D. Disposal: Legally dispose of waste off site. Dispose of waste regularly.
- i. Burning On Site: Prohibited.
  - ii. Burial On Site: Prohibited.
  - iii. Liquid Disposal into Storm or Sanitary Sewers: Prohibited
  - iv. Hazardous Material Disposal: Comply with requirements of authorities having jurisdiction.
- E. Adjacent Areas: Keep adjacent areas free of construction debris and waste.
- F. Dust Control - Exterior: Effectively control dust resulting from work of the Contract.
- i. Wet travel areas, debris stockpiles, soil material stockpiles, and other work.
  - ii. Do not create ice hazards in freezing weather.
  - iii. Cover stockpiles with weighted, dust proof tarpaulins.
  - iv. Locate soil material storage piles away from public ways and pedestrian areas.
- G. Dust Control - Interior: Effectively control dust resulting from work of the Contract. Contain dust within the Work Limits.

- i. Do not allow dust to damage any new work.
  - ii. Effectively prevent dust from entering ventilation systems.
  - iii. Effectively cover, seal, and protect ducts, diffusers, grilles, louvers, and vents.
  - iv. Effectively cover, seal, and protect fire detection and alarm system components.
  - v. Effectively cover, seal, and protect light fixtures and lamps.
  - vi. For dust producing activities, use tools with directly attached vacuum hoses.
  - vii. Vacuum or wet clean instead of dry sweeping to minimize dust from brooming.
    - a. Do not wet clean surfaces which could be damaged by water.
  - viii. Do not clean by using blown compressed air unless concurrent vacuums are used.
- H. Street Cleaning: See “Trucking” above and requirement to wash tires and wheels.
- i. Comply with requirements of authorities having jurisdiction.
  - ii. Clean public ways to remove soil and debris resulting from Contract work.
  - iii. Clean Owner’s private roads to remove soil and debris resulting from Contract work.

3.4 TEMPORARY SIGNS:

- A. Construction Manager to provide jobsite signs per KUA requirements.
- B. Zoning Ordinances: Comply with requirements of authorities having jurisdiction prior to erection.
  - i. Sign Restrictions: Only project identification sign and safety and warning signs are permitted.
  - ii. Construction Entrance Signs: Provide signs to clearly identify and direct drivers to construction entrances. Provide signs prohibiting construction traffic from other entrances and drives.
- C. Project Identification Sign: to provide Project Identification sign per KUA requirements.
  - i. Sign Size: As shown or, if not shown, 4 feet by 8 feet.
  - ii. Graphics: Full color 3M "Scotch Print" and vinyl die cut sign computer graphics.
  - iii. Location: Locate and orient sign as field directed by Architect.
  - iv. Sign Erection: Support sign panel with 4 x 4 posts and 2 x 4 rails, braces and stakes.
  - v. Painting: Paint support posts, framing, braces, and stakes. Color directed by Architect.
  - vi. Final Disposition: Remove sign panel and provide to Owner when directed by Owner.
  - vii. Disposal: Remove and dispose of posts, framing, braces, and stakes.

3.5 REMOVAL OF TEMPORARY WORK: Demolish, remove, and dispose of all temporary work.

- A. Definition of “Temporary Work”: All items including, without limitation, utilities, services, construction, assemblies, partitions, trailers, and other items which are not intended to be part of the permanent work of the Contract.

B. When: When each item of temporary work is no longer needed, Construction Managers shall propose date of removal and obtain Owner's and Architect's approval prior to removal.

i. Owner Directed Dates: The Owner retains the option and right to direct the Construction Manager to remove temporary work on specific dates and the Construction Manager shall comply.

C. Patching: When removal of temporary work results in need for patching or repair, provide all patching and repair needed.

3.6 OTHER CONTRACTORS EMPLOYED BY THE OWNER AND WORKING CONCURRENTLY: Other contractors employed by the Owner and working concurrently within the work limits may include, without limitation, specialty system contractors and furnishing contractors.

A. Construction Manager's Responsibilities: Cooperate with other contractors employed by the Owner and working concurrently within the work limits. Allow them to work as if they were a minor sub-contractor. Provide the following temporary facilities and controls to support the work of other contractors employed by the Owner:

B. Other Contractor's Responsibilities: Other contractors employed by the Owner must cooperate with the Construction Manager and respect their needs on the site and their schedules. Other contractors employed by the Owner shall not rely on tools, equipment, labor or supervision from the prime Contractors. Other contractors employed by the Owner shall follow jobsite protocols set by the General Construction Construction Manager, especially in regards to site safety.

END SECTION 015000 KUA TEMPORARY FACILITIES AND CONTROLS

**015240 KUA CONSTRUCTION WASTE MANAGEMENT**

1. SUMMARY

This section contains administrative and procedural requirements for the recycling and reuse of non-hazardous construction waste as well as the disposal of any non-hazardous construction waste.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		
Product Cut Sheets		
Product Samples		
Mock-ups		
Closeout submittals		
Other	X	1. Construction Manager/Contractors' Waste Management Plan – for review at least 7 days prior to the commencement of construction.

3. PRODUCTS - STRATEGIES

A. CONSTRUCTION MANAGERS' WASTE MANAGEMENT PLAN

- i. General: Develop a plan consisting of waste identification and reduction. The plan shall be submitted to the Owner and Architect for review prior to mobilization on site.
- ii. Waste Identification: Indicate and anticipate types and quantities of demolition, site-clearing, and construction waste to be generated by the project.
- iii. Waste Reduction: Prepare a guide indicating types of waste, whether it will be recycled, reused, or disposed of in a landfill.
  - a. Recycled Materials
  - b. Reusable Materials: Include a list of materials to be set aside and reused in the new construction as well as those that are of good condition to be made available to members of the community/re-use shed at transfer station.
  - c. Disposed Materials: Indicate how and where remaining materials will be disposed of.
- iv. Develop construction site plan that highlights locations established for salvage, recycling, and disposal.

4. EXECUTION & QUALITY CONTROL

A. WASTE MANAGEMENT CONFERENCE

- i. Construction Manager shall conduct a conference at the start of construction and routinely to inform workers and subcontractors of requirements and desired outcomes for waste management practices.
- ii. Plan Implementation: Implement waste management plan as approved by architect and owner. Provide handling, containers, storage, signage, transportation, and other support as needed to implement the plan for the entire duration of the project.
- iii. Training: Train workers, subcontractors, and suppliers on proper waste management procedures as appropriate for their specific work on the project.
  - a. Distribute Waste Management Plan to all Train workers, subcontractors, and suppliers.
  - b. Distribute Waste Management Plan to entities when they first begin work on site. Review plan, procedures, and locations established for salvage, recycling, and disposal.
- iv. Site Access & Temporary Controls: Conduct waste management practices to ensure minimum interference with roads, streets, walks, walkways, and adjacent occupied facilities.
  - a. Designate and label specific areas on the site for separating materials to be salvaged, recycled, reused, donated, and sold.
  - b. Comply with Division 1 Section Temporary Facilities and Controls for controlling dust and dirt, environmental protection, and noise control.

B. RECYCLING CONSTRUCTION WASTE, GENERAL

- i. Procedures: Separate recyclable waste from other waste materials, trash and debris. Separate recyclable waste type to the maximum extent practical.
  - a. Provide marked containers for controlling recyclable materials. Include a list of acceptable materials for each bin at each bin.
  - b. Inspect each bin for contamination and correct as necessary.
  - c. Stockpile materials on site without intermixing. Place, grade, shape, stockpiled material to drain surface water. Cover to minimize windblown dust.
  - d. Stockpile material away from construction area. Do not store within the dripline of any tree.
  - e. Store components off the ground and protect from the weather.
  - f. Remove all recyclable waste off the property periodically and at project end and transport as appropriate to recycling receiver or processor.

C. RECYCLING CONSTRUCTION WASTE

- i. Packaging
  - a. Cardboard & Boxes: break down into flat sheets. Bundle and store in dry location.
  - b. Polystyrene Packaging: Separate material.
  - c. Pallets: As much as possible, require deliveries that use pallets to remove pallets from project site. For pallets that remain on site, offer to owner, workers before breaking down and adhering to policies for recycling wood.
  - d. Crates: Break down crates and adhere to policies for recycling wood.



- ii. Site Clearing Wastes: chip brush, branches and trees at landfill facility.
  - iii. Wood Materials:
    - a. Clean lumber cut-offs: Offer to owner, workers, before grinding or chipping into small pieces.
    - b. Clean sawdust: Bag sawdust that does not contain painted or treated wood.
    - c. Engineered Wood Products: Offer any segments 3'-0" or longer to owner, workers, before disposal.
  - iv. Gypsum Board: Stack large, clean pieces on wood pallets and store in dry location.
  - v. Metal: All metals shall be sorted for recycling and salvageable scrap. Any scrap metal shall be salvaged and proceeds returned to the owner.
  - vi. Insulation:
    - a. Excess cellulose insulation shall be vacuumed up by the insulation contractor/installer for reuse.
    - b. Any spray foam insulation scraps, which should be minimal as it is primarily being used for air sealing, shall be separated from other construction debris and disposed of appropriately.
    - c. Any rigid foam scraps exceeding 1'-0" in either dimension shall be set aside and offered to the owner or workers prior to disposal.
    - d. Any fiberglass insulation removed from the existing facility or scrap from mechanical insulation shall be bundled and disposed of properly – landfill waste.
- D. DISPOSAL OF WASTE
- i. General: Except for items to be salvaged, recycled, or otherwise reused, remove waste materials from project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
    - a. Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on site.
    - b. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - ii. Burning: do not burn waste materials.
  - iii. Disposal: Transport Waste Materials off Owner's property and dispose of them legally.
- E. CONSTRUCTION WASTE TRACKING
- i. Provide documentation of quantities of each type of waste material (i.e. recycled, salvaged, wasted, composted, etc.) to architect along with each pay application.

END SECTION 015240 KUA CONSTRUCTION WASTE MANAGEMENT

**016000 KUA PRODUCT REQUIREMENTS**

1. SUMMARY

This section includes administrative and procedural requirements for building products.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Product Declarations	X	The Architect requests Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs) be requested of all subcontractors in Divisions 3 – 15. If not available, the CM and associated subcontractors must demonstrate that an adequate effort has been made to procure this information.
Mock-ups		
Closeout submittals		
Other	X	Compatibility Matrix for All Product in contact with each other.

3. GENERAL REQUIREMENTS FOR PRODUCTS

- A. New Products Required: Unless specifically required to be salvaged or reused, provide only new, recently produced materials, products, and equipment of the latest versions or models.
- B. Single Source Required: There are no single-sourced materials specified as part of this project. The architect and Owner will entertain substitutions for products specified – see 012500 Substitution Procedures.
- C. Packaging and Labels: Deliver items in original, undamaged, factory packaging with complete manufacturer's labels.
- D. Permanent Labels, Trade Marks, & Trade Names: Locate in inconspicuous locations acceptable to Architect.
- E. Equipment Data Plates: Provide permanent data plate on each item. Include manufacturer, model, serial number, date of manufacture, capacity, ratings, power requirements, and other essential data.
- F. Strikes, Delays: Before contracting for materials, products, and equipment, investigate potential for strikes and other delays. Avoid purchasing items subject to known possible delays.

- G. Asbestos Restrictions: For all work of the Contract, do not use or incorporate into the work any material containing asbestos in any form.
1. Construction Manager is solely responsible for all costs of remediating materials containing asbestos brought to the Owner's property by the Construction Manager, subcontractor, or supplier.
- H. Hazardous Materials Restrictions: Do not use or incorporate into the work any hazardous materials.
1. "Hazardous material" includes materials regulated under OSHA Hazard Communication Standard, 29 CFR 1910.1200.
  2. The Construction Manager is solely responsible for all costs of remediating hazardous materials brought to the Owner's property by the Construction Manager, subcontractor, or supplier.
- I. Material Safety Data Sheets: Obtain, study, and submit Material Safety Data Sheets for every material and product prior to first use on site.
1. Identify all hazardous materials and conditions.
  2. Comply with all safety information and recommendations.
  3. Maintain complete MSDS file on site organized by specification section.
- J. "Right to Know" Laws: Comply with "Right To Know" laws and requirements of authorities having jurisdiction.
- K. Odors: Use no or low odor materials.
1. When odor is unavoidable, submit sample and obtain Owner's approval prior to bulk purchase. Note: Most products specified herein are low or no VOC containing products. The Construction Manager shall confirm that any odor-producing materials do meet the VOC thresholds specified.
- L. Compatibility: For all materials in contact:
1. Provide evidence of compatibility. The architect requires use of a compatibility matrix for all products to demonstrate compatibility, and will share this format with the Construction Manager upon request.
  2. When evidence is not available, provide custom testing to prove compatibility.

3. When materials in contact are not compatible, provide additional, compatible transition interface materials and provide details of each transition.
- 3.1.1 DELIVERY, STORAGE, HANDLING: Transport, deliver, unload, handle, and store items in compliance with the manufacturer's instructions and recommendations. Protect items from all damage, deterioration, loss, and theft. Minimize on site storage time. Maintain environmental conditions, temperature, ventilation, and humidity within range recommended by manufacturer.
- A. Additional On-Site Storage Requirements: Store off the ground and under cover, or indoors in dry, well-ventilated areas.
    1. Confine storage to within the Work Limits.
    2. Store flat, stacked or leaning as appropriate for each product or material.
    3. Provide separators between finished materials to prevent marring and damage.
    4. Provide temporary storage trailers for items subject to weather damage and which cannot be stored inside buildings.
  - B. Additional Off-Site Storage Requirements for Items and Work Paid For or Partly Paid For By Owner:
    1. Provide Bill of Sale giving Owner total and sole ownership of property.
    2. Store in a bonded warehouse preapproved by Owner. Pay all warehousing costs.
    3. Provide written warehouse contract allowing Owner to inspect property during business hours.
    4. Provide written warehouse contract allowing Owner to take possession of property at any time during business hours.
    5. Provide and maintain insurance against all losses for the full value of the property.
    6. Pay all insurance costs.
    7. If insurance is in the name of the Construction Manager, the Owner shall be named on the Insurance Certificate as an "Additional Insured" party.

END SECTION 016000 KUA PRODUCT REQUIREMENTS

**016115 KUA FASTENER REQUIREMENTS**

1. SUMMARY

This section includes administrative and procedural requirements for fasteners.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		

3.0 GENERAL REQUIREMENTS FOR FASTENERS

- A. Fasteners: “Fasteners” includes nails, screws, bolts, wedge bolts, expansion bolts, chemical bolts, epoxy anchors, pins, powder actuated devices, and all other types of mechanical connections.
- B. Completely Specified Fasteners: Where fasteners are completely specified in the Contract Documents, provide the specified fasteners.
  - 1. “Completely specified” means the fastener type, material, finish, size, diameter, length, and spacing are specified.
- C. Fasteners Not Completely Specified: Fasteners may not be completely specified in the Contract Documents:
  - 1. To allow the Construction Manager to control means, methods, and techniques of construction.
  - 2. When “Engineering by Construction Manager” is required.
- D. Fasteners Selected by Construction Manager: For fasteners not completely specified in the Contract Documents, the Construction Manager shall:
  - 1. Select fasteners appropriate for each condition, substrate, load, and exposure.
  - 2. Use fastener manufacturer’s published load tables to determine fastener size and spacing.

3. Provide a factor of safety of four or higher.
    - a. Working load shall be maximum 25 percent of ultimate load capacity.
  4. Provide corrosion resistance at least equivalent to items being fastened.
  5. Obtain Architect's approval of each fastener prior to use.
  6. Install fasteners in compliance with the fastener manufacturer's recommendations.
- E. Fasteners for "Engineering by Construction Manager": Provide fasteners indicated on the approved, engineered shop drawings.
- F. Submittals: For each fastener used, submit manufacturer's data including load capacity, factor of safety, instructions, recommendations, and restrictions.
- 3.1 GENERAL REQUIREMENTS FOR STRUCTURAL FASTENERS: See structural drawings for structural fasteners requirements and specifications. Some fasteners will require submittals. In selecting structural fasteners without submittals, ensure compliance with structural specifications, and comply with fastener manufacturer's instructions, recommendations, and limitations.
- A. Working Load Capacity: Install each fastener to achieve the fastener manufacturer's published working load capacity.
1. Working load capacity is not ultimate load capacity.
  2. Working load capacity, if not published, shall be maximum 25 percent of manufacturer's published ultimate load capacity.
- B. Torque: Torque each fastener within the min/max range recommended by fastener manufacturer.
- C. Fasteners Requiring Pre-drilling or "Pilot" Holes:
1. Use only the fastener manufacturer's recommended coordinated drill bit diameter.
  2. Drill hole to depth recommended by fastener manufacturer.
  3. Clean holes prior to installation of fasteners.
  4. These are important requirements that significantly impact structural capacity.
- D. Quantity: As shown or, if not shown:
1. Provide one fastener for each factory provided fastener hole in item being fastened.
  2. Provide at least two fasteners for each individual item being fastened.

3. Provide quantity to provide fastener working load capacity at least four times the actual load.

**3.2 INSPECTING AND TESTING FASTENERS:**

**A. Scope of Inspection and Testing: 100 percent of installed:**

1. Structural fasteners.
2. Fasteners penetrating air barriers, water barriers, flashings.

**B. “Deficient Fastener” Definition: A fastener with one or more of these characteristics:**

1. Fastener is not the specified or approved fastener.
2. Fastener is not the correct size, diameter, type, material, alloy, thread, finish, or appearance.
3. Drive head or threads are stripped.
4. Fastener is broken or damaged.
5. Fastener misses the intended framing or substrate.
6. For light gage metal substrates, less than three threads penetrate completely through.
7. Fastener cannot be tightened.
8. Fastener cannot be torqued to the fastener manufacturer’s recommended torque.
9. Fastener does not provide the intended or required load capacity.
10. Required washers are missing.
11. Visible appearance is damaged.

**3.3 DEFICIENT FASTENER PROCEDURE:**

- A. Report deficient fasteners to Owner and Architect in writing with location photos and diagrams.
- B. Mark head of each deficient fastener bright red. Do not mark adjacent surfaces.
- C. Do not conceal deficient fasteners, until approved remediation is completed.
- D. Do not remove deficient fasteners, unless removal is part of approved remediation procedure.

1. Removing deficient fasteners may cause unwanted holes, air infiltration, and water leaks.
- E. Propose remediation procedure to Owner and Architect including, without limitation:
1. Removal, correction or replacement of deficient fasteners.
  2. Restoration of damaged air barriers, flashings, sheathings, and related work.
- F. Execute approved remediation procedure.
- G. Re-inspect and retest every remediated fastener to prove the fastener is no longer deficient.

END SECTION 016115 KUA FASTENER REQUIREMENTS



**016402 KUA OWNER FURNISHED REQUIREMENTS**

1. SUMMARY

This section includes administrative and procedural requirements for owner furnished items.

Related Sections: This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		
Other	x	Owner & Architect to share any layout information required for the GC to assist in coordinate installation efforts.

3. GENERAL REQUIREMENTS

3.1 SECTION INCLUDES: General requirements for “Owner Furnished” items.

A. The majority of Owner-Furnished items on this project are loose items such as furniture, bike racks, etc. The Construction Manager (CM) is not responsible for receiving or installing these items. The Owner will arrange for the install of these items, including coordinating with the Construction Manager’s work to prevent work conflicts.

B. The Owner will furnish the following. Installation as noted below:

- i. Furniture
- ii. Computers and associated IT hardware, install coordinated by the CM.
- iii. Toilet accessories as noted in specs – supplied by owner’s vendor, installed by CM
- iv. Security – design, equipment, and tie-ins by owner’s vendor, coordinated by CM
- v. Tele/data/AV – design, equipment, and tie-ins by owner’s vendor, coordinated by CM
- vi. Hazardous Materials Design and abatement – contracted directly by owner (Radon and lead paint work are by contractor)
- vii. Testing and special inspections by owner’s consultant, coordinated with contractor
- viii. Envl Cx by owner’s consultant, coordinated with contractor
- ix. Mech Cx by owner’s consultant, coordinated with contractor
- x. Utility connections– contracted directly by owner, coordinated by contractor
- xi. Time Capsule - Owner will supply a filled and sealed time capsule and sandstone plaque to contractor to be installed by Contractor in location TBD – likely underneath the medallion in the plaza. Time capsule BOD Product from:  
<https://www.futurepkg.com/timecapsules> .

END SECTION 016402 KUA OWNER FURNISHED REQUIREMENTS

## 017123 FIELD ENGINEERING

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Survey and field engineering
  - 1. Establishment and maintenance of layout and elevation control points.
  - 2. Horizontal and vertical lines and grades of all site improvements, servicing, utilities, architecture, furnishings, signage and for any other work required for the completion of the Project.
  - 3. Review of horizontal and vertical layout lines and grades, in the field, when requested by the Architect, Landscape Architect, Engineer(s), Owner, and/or Construction Manager prior to and during construction.
  - 4. Surveying accuracy and tolerances in setting survey stakes.
  - 5. Land Survey Work for Record and As-Built documents.
- B. Quality control
- C. Submittals
- D. Project record documents

#### 1.2 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 73 00 – Execution Requirements.
- C. Section 01 77 00 – Contract Closeout.
- D. See other Project Manual documents and Sections with specific requirements for layout, surveying and engineering.

#### 1.3 QUALITY ASSURANCE

- A. Employ a Land Surveyor registered in the State of New Hampshire and acceptable to Architect/Engineer, to perform survey work of this section.
- B. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.
- C. Surveying Accuracy: Control traverse field surveys and computations, including surveys of main control lines to determine horizontal and vertical alignment of major structure components, shall meet the accuracy requirements for Second Order, Class 1 Surveys as specified by the National Oceanic and Atmospheric Administration (NOAA). Staking for construction or equipment installations shall meet the accuracy requirements of the Second Order, Class II Surveys as specified by NOAA.

#### 1.4 SUBMITTALS FOR REVIEW

- A. Submit name, address, and telephone number of Surveyor before starting survey work. On request, submit documentation verifying accuracy of survey work.

- B. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the Work are in conformance with Contract Documents.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and survey work as it progresses.
- B. On completion of foundation walls and major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.
- C. Submit Record Documents under provisions of the contract specifications.

#### 1.6 EXAMINATION

- A. Verify layout information shown on the Drawings, in relation to the base lines indicated on the Drawings and to existing benchmarks and control points.
- B. Establish and maintain benchmarks on the site, referenced to data established by survey control points.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  - 2. Quantity: Provide benchmarks as necessary to perform work. Provide additional benchmarks as requested by the Landscape Architect.
- C. Existing utilities and equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction.
  - 1. Prior to construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer and water service piping.
  - 2. The contractor shall perform a utility locate request through Dig Safe. Contractor shall fulfill the requirements of the Dig Safe System.
  - 3. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- D. Promptly notify Architect/Engineer of any discrepancies discovered.

#### 1.7 SURVEY REFERENCE POINTS

- A. Contractor to locate and protect survey control and reference points.
  - 1. Existing control points fall within the proposed Work area. Establish new control points, in reference to original control points, in areas convenient to but outside of the Work area, prior to the commencement of any Work. Confer with Owner, Construction Manager and Landscape Architect prior to establishing new control points.
  - 2. Do not change or relocate benchmarks or control points without prior written approval. Promptly report lost or destroyed reference points, or requirements to relocate reference points because of necessary changes in grades or locations. Base replacements on the original survey control points.
  - 3. Prepare a plan that shows the location (northing and easting) of the new control points

and the original control points. Submit the plan for the Landscape Architect's review and acceptance prior to beginning any Work.

- B. Control datum for survey is that indicated on Drawings.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect/Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.

#### 1.8 SURVEY REQUIREMENTS

- A. Provide field engineering services. Utilize recognized engineering survey practices.
- B. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- C. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
  - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
  - 2. Grid or axis for structures.
  - 3. Building foundation, column locations, and ground floor elevations.
- D. Periodically verify layouts by same means.
- E. Surveyor's Log: Maintain a surveyor's log of control points, benchmarks, and other survey work. Make this log available for reference.
  - 1. Record deviations from required lines and levels, and advise the Landscape Architect when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted and not corrected.
- F. Site Improvements: Locate and lay out site improvements, horizontally and vertically, including but not limited to: structures, fountains, wood elements, stone work, pavements, walls, steps, plantings, topsoil placement, fencing, aprons, curbs, ramps, lights, utilities, utility slopes and invert elevations, and stakes for grading, all by instrumentation and similar appropriate means.
  - 1. Provide horizontal and vertical layout information prior to beginning construction and as construction proceeds. Engineer and Landscape Architect shall have the right to request confirmation of all vertical and horizontal layouts of site improvements before, during and after construction.
  - 2. Strictly follow horizontal and vertical data provided in the Drawings.
  - 3. The Contractor shall verify dimensions shown on the Drawings and notify the Engineering and/or Landscape Architect before proceeding with the work in question. The Contractor shall not proceed in uncertainty.

4. Do not proceed with final Work until the Landscape Architect has given his/her acceptance of the layout of an area or element. Provide Landscape Architect a minimum of five (5) days notice that work will need to be reviewed.
  5. When requested, provide confirmation of all vertical and horizontal lines and grades of the Work before, during and after construction.
  6. Examine all documents to determine items that require approval of layout. Before proceeding with work, submit schedule for all layouts.
- G. Existing Utilities: Furnish information necessary to adjust, move or relocate existing structures, utility poles, lines, services or other appurtenances located in, or affected by construction. Coordinate with local authorities and public/ private utilities having jurisdiction.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
  2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- H. Equipment: The Contractor's instruments and other survey equipment shall be accurate, suitable for the surveys required in accordance with recognized professional standards, and in proper condition and adjustment at all times.

#### 1.9 SURVEYS FOR MEASUREMENT AND PAYMENT

- A. Perform surveys to determine quantities of unit cost and/or cost-plus work, including control surveys to establish measurement reference lines. Notify Architect/Engineer prior to starting work.
- B. Contractor's Engineer Responsibilities: Sign surveyor's field notes or keep duplicate field notes, and calculate and certify quantities for payment purposes.

#### PART 2 - PRODUCTS

Not Used.

#### PART 3 - EXECUTION

Not Used.

END OF SECTION

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**017302 KUA EXECUTION REQUIREMENTS**

1. SUMMARY

This section includes administrative and procedural requirements for execution of the construction work.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		

3. GENERAL EXECUTION REQUIREMENTS

A. Manufacturer’s Instructions and Recommendations: For each product and material including systems and assemblies, comply with the manufacturer’s installation and execution requirements and recommendations, except where more restrictive requirements are specified.

B. Examination By Construction Manager: Examine and inspect work daily to ensure compliance with Contract Documents.

C. Examination Required By Installers: Examine previous work, related work, and conditions under which work is to be performed.

1. Notification Required: Installer shall notify the Construction Manager in writing of all deficiencies and conditions detrimental to the proper completion of the installer’s work.

2. Acceptance: Beginning installation means the installer accepts and approves substrates, previous work, related work, and conditions.

D. Measurements and Tolerances: Confirm all measurements and dimensions.

1. Do not deviate from measurements and dimensions indicated in the Contract Documents. If a question or conflict occurs, request information from the design team.

2. Field check measurements and tolerances as the work progresses and at major mile stones.
    - a. Examples: Completion of foundations, structure, interior framing, ADA clearances.
  3. Notify Architect of differences between field dimensions and Contract Document dimensions.
    - a. Prepare and submit drawings showing deviations from Contract dimensions.
  4. Cumulative Tolerances: Confirm tolerances at each step in the work.
    - a. Do not allow tolerances to accumulate or “grow”.
- E. Installation Tolerances:
1. Plumb, Level, Aligned, Straightness:
    - a. 48 Inches or Less: Within 0.06 inch.
    - b. Over 48 Inches to 10 Feet: Within 0.125 inch.
    - c. Over 10 Feet to 20 Feet: Within 0.18 inch.
    - d. Over 20 Feet: Within 0.25 inch.
  2. Flush Across Joints: Within 0.03 inch.
  3. Curved Work: Provide true radii. Do not provide straight line, faceted approximations of curves.
    - a. Tolerance for Radii Up To 12 Inches: 0.06 inch.
    - b. Tolerance for Radii Over 12 Inches To 48 Inches: 0.125 inch.
    - c. Tolerance for Radii Over 48 Inches To 10 Feet: 0.18 inch.
    - d. Tolerance for Radii Over 10 Feet: 0.25 inch.
- F. Approval before Concealment: Obtain inspections and approvals before concealing any work.
1. Acoustical Ceilings: This requirement also applies to acoustical ceilings.
- G. Layout of Work: Employ competent persons to establish all lines, elevations, and measurements.

1. Provide and maintain lines, bench marks, and other temporary working points.
  2. Convert temporary working points to permanent working points at the earliest practical time.
  3. Do not deviate from indicated lines and elevations without Architect's written prior approval.
- H. Architect's Review of Interior Layout:
1. Layout interior partitions and doorways on floor with temporary markings.
  2. Obtain Architect's approval of layout prior to continuing work.
  3. Make minor adjustments directed by Architect at no change in Contract Amount.
  4. If the Construction Manager claims the adjustment directed by Architect is not minor, the Construction Manager shall notify the Architect and follow Contract construction change procedures.
  5. Do not perform any work which would change the Contract Amount without first obtaining an approved Change Order.
- I. Extent of Floor Finishes: Extend finishes:
1. Continue under all open bottom items, movable fixtures, movable equipment, furnishings, and casework.
  2. Continue into closets, recesses, alcoves, and toe spaces.
  3. Over removable and fixed covers and plates. Keep removable items removable.
  4. Close to walls, columns, and other permanent items.
- J. Galvanic Isolation: Isolate dissimilar metals with non-absorptive dielectric material, isolation tape, isolation coatings, or other isolator preapproved by Architect.
- K. Foundation Survey: Survey foundation form work prior to placement of concrete.
1. Use an experienced site layout worker or a Registered Professional Engineer or Land Surveyor to conduct survey.
  2. Provide scaled drawing showing property lines, foundation dimensions, and setbacks.
  3. Coordinate this survey check with a site visit by the project civil engineer for timely confirmation of the survey before proceeding with foundation construction.



- L. Site Concrete Joints: Review layout/scoring pattern of saw cuts and construction joints with Architect prior to installation.

END SECTION 017302 KUA EXECUTION REQUIREMENTS

**017600 KUA PROTECTING INSTALLED CONSTRUCTION**

1. SUMMARY

This section includes general requirements for protecting installed and existing to remain construction in areas of work.

This pertains especially to the building structural systems as they are meant to be exposed to finish.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		

3. REQUIREMENTS

- A. Protection - General: Protect and keep clean all installed work from all damage and deterioration.
  - 1. The Construction Manager is responsible for means, methods, and techniques used.
  - 2. Protect doors, door frames, and hardware.
  - 3. Protect floors from traffic, rolling loads, static loads, drags, marks, damage, and deterioration.
  - 4. Protect walls from impact, dents, marks, damage, and deterioration.
  - 5. Protect glass from damage including staining and etching. Keep glass clean.
  - 6. Protect fibrous, paper faced materials, and water sensitive materials from water and moisture.
  - 7. Protect all exposed wood and steel structural elements, interior and exterior – columns, beams, panels, and floor/ceiling systems.

- B. Roofing, Waterproofing: Restrict and control work *over* installed roofing and waterproofing.
  - 1. Provide temporary walkways and work platforms.
  - 2. Work and traffic directly on roofing and waterproofing is prohibited.
  - 3. Protect roofing and waterproofing from solvents and contamination.
  
- C. Remediation: Remove all damaged and deteriorated materials including materials which show evidence of biological growth, mold, or mildew.
  - 1. Replace with new work complying with Contract requirements.

END OF SECTION 017600 KUA PROTECTING INSTALLED CONSTRUCTION

**017700 KUA CLOSEOUT PROCEDURES**

1. SUMMARY

This section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Closeout Submittals
2. Substantial Completion procedures.
3. List of Incomplete Items (Punch List)
4. O&M Data and Manual
5. Final cleaning.
6. Repair of the Work.
7. Final completion procedures.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals	<b>X</b>	Closeout Submittals

3. REQUIREMENTS

3.1 SUBSTANTIAL COMPLETION PROCEDURES

A. Punch List/Construction Manager's List of Incomplete Items: Construction Manager to prepare a list (punch list) of incomplete items and/or items that require correction in order to bring work into compliance with Contract Documents, indicating the value of each item on the list and reasons why the Work is incomplete. Submit list to Architect, Owner’s Representatives, and Owner. Work with Architect, Owner’s Project Manager, and Owner to verify accuracy and completeness of the list including any revisions, additions or deletions as necessary. Submit revised list that incorporates any required revisions to Architect, Owner’s Project Manager, and Owner, indicating the value of each item on the list and the timeline for correction or completion. See Section 3.2 below for additional punch list information.

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

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  2. Consent of Surety/Sureties: if applicable for any reduction in or partial release of retainage or final payment.
  3. Submit test/adjust/balance records.
  4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  5. Other documentation or certifications required by Owner's lender, releases of lien, bond waivers, etc.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of ten days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
  6. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  7. Complete final cleaning requirements, including touchup painting.
  8. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
  9. Submit Warranties, Record Documents, Certificates of Occupancy, Project Photographs, and all required digital files.
  10. Remove temporary facilities, change lock cylinders and cores and submit any keys to Owner, and deliver specified maintenance stocks of materials.
- D. Inspection: To be Substantially Complete, the work shall be at least 99 percent complete as indicated on approved payment requests. Submit a request for inspection to determine Substantial Completion a minimum of ten days prior to date the work will be completed and ready for final inspection and tests. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Construction Manager of items, either on the Construction Manager'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. The architect or the architect's consulting engineers will perform no more than two re-inspections. Thereafter, the Construction Manager will be responsible for reimbursing the Owner for these additional services.
  2. Results of completed inspection will form the basis of requirements for final completion.

- E. Architect's action at Substantial Completion: After Construction Manager completes all prerequisites to Substantial Completion, the Architect and Owner's representatives will review the project and the Architect will either issue a 'Certificate of Substantial Completion' or notify the Construction Manager of the reasons said certificate will not be issued.

3.2 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 Construction Manager that are outside the limits of construction.
1. Organize list of spaces in sequential order.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Construction Manager.
    - d. Page number.
  4. Submit list of incomplete items in the following format:
    - a. MS Excel electronic file. Architect and/or Owner's Project Manager may revise or supplement the Punch List. Architect will return an annotated file.
- B. Completion of Punch List: Complete Punch List work items within 15 days.

3.3 SEE SECTION 017836 – WARRANTIES FOR PROJECT WARRANTY REQUIREMENTS

3.4 OPERATIONS AND MAINTENANCE DATA

- A. Format:
1. PDF electronic files with composite electronic index on digital media acceptable to Architect. Include a complete O+M table of contents.
  2. Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, one set of copies.
- B. Emergency Manuals: Types of emergencies, emergency instructions, and emergency procedures.
- C. Operation Manuals: System, subsystem, and equipment descriptions, operating procedures, wiring diagrams, control diagrams and sequence of operation, and piped system diagrams.
- D. Product Maintenance Manuals: Source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds.
- E. Systems and Equipment Maintenance Manuals: Source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds.

- F. Final listing/matrix of all installed finishes organized/identified by room/space name and including material type/product, manufacture name, finish/color, etc. for the owner's reference and ease of use for future replacement and/or repair.
  - G. Copies of Inspections and Inspection Reports and notations from regulatory agencies (AHJs) including but not limited to:
    - 1. Fire Safety
    - 2. Electrical
    - 3. Plumbing
    - 4. Town
  - H. Final inspection and commissioning reports including responses from Construction Manager and/or subcontractor(s) noting how the raised concerns/issues were addressed and/or resolved.
  - I. Final Record submittals including review comments and/or notations.
- 3.5 FINAL CLEANING –Interior spaces to be left broom clean. Exterior spaces to be free of all construction materials, equipment and tools, and other related items. Clean and obtain approval immediately before Owner occupancy.
- A. Remove surplus materials.
  - B. Locate and store maintenance stock where directed by Owner.
  - C. Remove debris. Broom clean all interior surfaces.
  - D. Remove dust, soil, markings, stains, contamination, and foreign substances from all surfaces.
  - E. Remove dust and debris from all horizontal elements including tops of frames and moldings.
  - F. Clean all surfaces in compliance with the surface manufacturer's recommendations.
  - G. Remove temporary labels and signs.
  - H. Remove "permanent" labels except when in inconspicuous locations approved by Architect.
  - I. Remove visible contractor and installer signs, labels, tags, names, and markings.
  - J. Clean painted and shiny surfaces.
  - K. Clean all interior and exterior glass surfaces with commercial glass cleaner.
  - L. Vacuum carpets, rugs, and mats.
  - M. Clean hard floors as specified.

- O. Clean and polish plumbing fixtures and fittings.
- P. Vacuum all HVAC system air inlets and outlets.
- Q. Clean light fixtures and lamps.
- R. Remove temporary construction and services.
- S. Remove temporary protection.

### 3.6 REPAIR OF THE WORK

- A. Complete repair and restoration operations, as identified by the Punch List, before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
  - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
  - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

### 3.7 FINAL COMPLETION PROCEDURES

- A. Prerequisites to Final Completion (complete prior to requesting Final Completion):
  - 1. Obtain Architect and Owner approval for a completed punch list;
  - 2. Apply for Final Payment;
  - 3. Submit final lien waivers and Affidavits if Release of Lien;
  - 4. Submit final Consent of Surety to Final Payment;
  - 5. Submit evidence of ongoing insurance coverage;



- B. Upon completion of the above procedures and delivery of the above referenced materials, certifications and documents: Submit a request for final inspection to the Architect for their review and to determine Final completion of the project and as described in AIA contract B101-2017.
  
- C. Architect's Action at Final Completion: After the Construction Manager submits all prerequisites to Final Completion, the Architect will either issue a 'Certificate of Final Completion' or respond with a list of reasons a 'Certificate of Final Completion' will not be issued.
  
- D. If the Construction Manager's submission for Final Payment requires multiple attempts, time spent processing this information by the Architect and/or the Owner's Project Manager will be deducted from the Contractor's Final Payment.

END SECTION 017700 KUA CLOSEOUT PROCEDURES

**017800 KUA RECORD DOCUMENTS**

1. SUMMARY

This section includes administrative and procedural requirements for record documentation.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals	X	Record Documents

3. REQUIREMENTS

3.0 RECORD DOCUMENT REQUIREMENTS:

A. Record Documents Required: The following Record Documents are required:

1. Record Drawings.
2. Binders:
  - a. Contract Specifications.
  - b. Maintenance and Owner’s manuals.
  - c. Warranties.
  - d. Maintenance agreements.
  - e. Test reports and inspections.
  - f. EPDs & HPDs
3. Building mounted charts and data.
4. Record submittals.

- B. Record Document Information and Content Required: Compile and incorporate information from:
1. Original Contract Documents.
  2. Addenda.
  3. Coordination drawings.
  4. Change Order modifications.
  5. Construction change directives.
  6. Field directions and instructions from the Owner or Architect.
  7. All changes and deviations from the original Contract Documents including, without limitation, actual installed locations, elevations, and inverts, including site work, measured from building structure with 0.1 foot accuracy.
- C. Cost of Record Documents: Record Documents are required under “General Conditions” and “General Requirements”. The cost of General Conditions and General Requirements are included in the Contract Amount.
1. Changes in the Work: Recording changes in the Work is an essential function of Record Documents. The cost of preparing Record Documents related to changes in the work shall be included in the “General Conditions” and “General Requirements” cost of each change in the work.
- D. “In Progress Record Documents”: “In Progress Record Documents” are working drafts of “Final Record Documents”.
1. Identify, file, and store “In Progress Record Documents” separately from other documents.
  2. Maintain “In Progress Record Documents” neat, clean, and well ordered at all times.
  3. Maintain “In Progress Record Documents” accurately up to date at least weekly.
  4. Keep “In Progress Record Documents” readily accessible at all times and at least weekly.
  5. Maintaining “In Progress Record Documents” is required for approval of progress payments.
  6. Approval of “In Progress Record Documents” is a prerequisite for Substantial Completion.

- E. Additional Requirements for “In Progress Record Drawings”:
1. Provide and maintain a separate “In Progress Record Drawing Set” for each major trade.
  2. The separate “In Progress Record Drawing Sets” may be stored and marked up in the Construction Manager’s on-site office or in each trade’s office.
  3. At appropriate intervals, the Construction Manager shall collect and compile all separate “In Progress Record Drawing Sets” in the Construction Manager’s on-site office for review and checking by the Construction Manager.
  4. At least once per month, the Construction Manager shall collect and compile all separate “In Progress Record Drawing Sets” in the Construction Manager’s on-site office for review by the Owner’s Project Manager.
- F. “Final Record Documents” - General: After approval of “In Progress Record Documents” at Substantial Completion, prepare and submit “Final Record Documents”.
1. Identification: Clearly label as “Final Record Document” and submission date.
  2. Title Blocks: Keep original Contract Document title blocks and sheet numbers.
  3. Professional Seals: Remove all professional seals and signatures from Record Documents.
  4. Room Numbers: Convert Contract Document room numbers to Owner’s final room numbers.
  5. Information Incorporation: Revise, change, and modify original Contract Documents with Record Document information.
    - a. Transfer and insert the Record Document information into the original Contract Documents.
    - b. Do not simply append Record Document information to the original Contract Documents.
- H. Additional Requirements for “Final Record Documents In Binders”:
1. “Record Documents In Binders”: Provide separate binders for each of the following:
    - a. Contract Specifications.
    - b. Maintenance and Owner’s manuals.

- c. Warranties.
  - d. Maintenance agreements.
  - e. Test reports and inspections.
2. Binders: Extra heavy duty, three ring.
3. Labels: Laser printed job name and record document titles on cover and spine
4. Copies: Submit two identical hard copies of each binder.
  - a. Electronic Copy: Submit three complete copies of entire contents of each binder electronically as Acrobat PDF documents.
5. Contents: Insert a table of contents in the front of each binder.
6. Tab Dividers: Provide color coded tab dividers related to the table of contents.
  - a. In general, organize by specification section number and division.
7. Plastic Sleeves: Insert all pages in heavy gage, clear, archive quality sleeves.
  - a. Exclusion: This requirement does not apply to Record Specification pages.
8. Record Specifications: Provide a clean, new copy of the Contract Specifications.
  - a. Incorporate all addenda and changes. Indicate addenda numbers, change order numbers.
  - b. Identify manufacturers, products, model numbers, and colors actually used on the Project.
  - c. Indicate all substitutions.
  - d. Indicate all deviations.
9. Maintenance and Owner's Manuals: Compile and provide maintenance and Owner's Manuals which include at least the following content:
  - a. Equipment lists with serial numbers.
  - b. Valve tagging schedules and flow diagrams.
  - c. Schematic diagrams of systems and written description of system and each component.

- d. Schematic diagrams of equipment wiring.
  - e. Reflected ceiling plans showing accurate location of each valve and control device.
  - f. Copies of electrical panel board directories.
  - g. Emergency instructions for each item.
  - h. Complete parts listings and sources of replacement parts.
  - i. Recommended inspection schedules and procedures.
  - j. General and routine maintenance instructions.
  - k. Listing of original equipment installers, suppliers, and distributors.
  - l. Lubrication schedule and list of types of lubricants to be used for each item.
  - m. Detailed information on maintaining, cleaning, and refinishing architectural finishes.
  - n. Detailed information on routine maintenance and inspection of roofing systems.
  - o. Final balancing reports for mechanical systems.
  - p. Mechanical system water treatment procedures and tests performed.
10. Warranties – see Section 017836 for specific Warranty Requirements.
11. Maintenance Agreements: Submit complete, signed, and legally binding agreements.
- a. Indicate expiration dates.
  - b. Indicate inclusions and exclusions.
  - c. Indicate Owner’s responsibilities.
12. Test Reports and Inspections: Compile all test reports and inspections.
- a. Include complete information received during the Contract.
  - b. Organize by Contract Specification number.
- I. Additional Requirements for “Final Record Documents Mounted in the Building”:

1. Content:
    - a. Electrical panel board directories.
    - b. Valve charts with valve numbers, purpose, and location tied to key plan.
  2. Room Numbers: Use Owner's final room numbers.
    - a. Do not use Contract Document room numbers if different than Owner's final room numbers.
  3. Locations: Wall mounted in mechanical and electrical rooms as preapproved by Owner and Architect.
- J. Additional Requirements for "Record Submittals": Submit Acrobat PDF copies of all submittals required under Section 013300 Submittal Procedures.
1. See Section 013300 "Submittal Procedures," *Submittal Quantities* and *Additional Submittals Concurrent Directly To Owner*.
- 3.1 ROOM NUMBERS: Use Owner's final room numbers for:
- A. Electrical panel board directories.
  - B. Fire alarm directories.
  - C. All other directories, signs, and labels.
  - D. Record documents of all types.
- 3.2 OWNER TRAINING REQUIREMENTS: Begin training after systems are fully commissioned, operational, and working well. Video recording of trainings to be provided as digital copy for owner's use/reference.
- A. Instructors: All instructors are subject to the Owner's approval. Replace instructors and reschedule training upon Owner's request at no additional cost to Owner.
    1. Instructors shall be competent and knowledgeable with excellent communication skills.
    2. Instructors shall be prepared with a preplanned training program.
  - B. Hours of Owner Training: As specified in technical specification sections or, if not specified, at least one-half day, generally broken down as follows:

1. General overview of Record Documents: 5 percent of training time.
  2. HVAC controls, systems, and equipment: 60 percent of training time.
  3. Plumbing systems and equipment: 5 percent of training time.
  4. Fire protection systems and equipment: 5 percent of training time.
  5. Electrical systems and equipment: 15 percent of training time.
  6. Other systems and equipment: 10 percent of training time.
- C. Training Session Topics: Address at least the following topics:
1. Safety.
  2. Proper operation including start up, shut down, and operation in all possible modes.
  3. Seasonal change over requirements.
  4. Emergency procedures.
  5. Preventive and routine maintenance.
  6. Special tools needed.
  7. Spare parts inventory recommendations.
- E. Training Completion: Obtain written acknowledgement from Owner that training was completed.

**3.3 SITE WORK RECORD DRAWING REQUIREMENTS:**

- A. Measurement Accuracy: Provide measurements with the following accuracy:
1. Vertical: Within 0.1 foot.
  2. Horizontal: Within 1 foot measured from permanent structures.
- B. Required Site Work Record Drawing Information:
1. Sanitary manhole – rims/inverts
  2. Sanitary cleanout – invert
  3. Sanitary pipe – building invert



4. Storm manhole/CB – rims/inverts/sump
5. Storm cleanout – invert
6. Storm pipe – change slope/bend
7. Storm pipe – building invert
8. Water main – top pipe (every 36' max.)
9. Water bends/tees/reducers/fittings – top pipe
10. Water valves/hydrants – top pipe
11. Electric – Secondary – change slope/bend
12. Electric – Secondary – top concrete (every 36' max.)
13. Electric – Secondary – trench cross-section (number and type conduit, encasement detail)
14. Tel/Data – location, depth, and number of conduit
15. Gas – top pipe (every 36' max.)
16. Gas – tees/valves – top pipe
17. Foundation and Footing Drains: Exempt from Record Drawing requirements, except required for all deviations from Contract locations and inverts.
18. Existing Utilities and Services: Locate, identify, measure, and record all existing utilities and services discovered or uncovered during the work of the Contract.

END SECTION 017800 KUA RECORD DOCUMENTS

**017836 KUA WARRANTIES**

1. SUMMARY

This section includes administrative and procedural requirements for project warranties.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals	X	Warranty Submission

3. REQUIREMENTS

3.1 REQUIREMENTS FOR ALL WARRANTIES AND GUARANTEES.

- A. Warranty Starting Dates: The Date of Substantial Completion of the entire project.
  - 1. Exception for Incomplete Work: Warranty starting date for work not completed by the Date of Substantial Completion shall be the date of final completion and acceptance of the incomplete work.
- B. Owner’s Rights: Warranties required under the Contract are in addition to and not in lieu of any remedy or warranty to which the Owner is entitled under law. Warranties required under the Contract are not a waiver of any of the Owner's rights.
- C. Warranty Forms: All warranty forms are subject to the Owner’s pre-approval.
  - 1. Submit warranty form and obtain approval prior to procuring work covered by the warranty.
  - 2. The Contract Documents may require special warranty terms and conditions which are not normal or standard for the manufacturer.
- D. Procurement: Do not procure materials, products, equipment, or work requiring warranties until confirmation that required warranties will be provided. Remove and replace materials, products, equipment, and work for which the required warranties are not available.
- E. Warranties are Irrevocable: Warranties issued to the Owner are irrevocable.

1. Non-Payment: If warrantor refuses to issue warranty or attempts to revoke warranty due to non payment by anyone other than the Owner, the Construction Manager shall correct the deficiency and cause the warranty to be issued or reinstated.
  2. Improper Installation: If warrantor refuses to issue warranty or attempts to revoke warranty due to improper installation or other deficiency, the Construction Manager shall correct the deficiency and cause the warranty to be issued or reinstated.
- F. Warranties are Transferable: All warranties shall permit the Owner to transfer or assign warranties to future owners or other assigns at no additional cost to the Owner.
- G. Pro Rated Warranties: Are not acceptable. Each warranty shall cover the full cost of warranty related repair throughout the full term of the warranty.
- H. Warranty Repairs Are Also Covered By Warranty: Work repaired or replaced under warranty shall be warranted for the full duration of the original warranty.
- I. Warranty Submission: Furnish originals of each executed warranty to Owner.
1. All warranties shall be complete, signed, conformed, and legally binding. Each warranty shall be accompanied by a description of the product or installation, including the name of the product and the name, address and telephone number of the installer, if not clear in the warranty.
  2. Submit a three-ring bound compilation of all warranties including the comprehensive total Contract warranty and each required long-term warranty.
  3. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Organize warranty documents in and orderly sequence based on the sequence of the Project Manual and provide bookmarked table of contents at beginning of document.
  4. Provide one additional copy of warranties to be included in the operations and Maintenance manual.
- J. Warrantor's Failure to Perform: The Owner may perform or may hire another entity to perform the warrantor's obligations. The Owner may recover its costs and damages from the warrantor in any court of competent jurisdiction.
- 3.2 COMPREHENSIVE, TOTAL CONTRACT WARRANTY: See A201-2017, 3.5 and 12.2.2. In addition to specific long-term warranties which may be required in individual specification sections, provide a Comprehensive Total Contract Warranty covering all work, materials, equipment, and labor of the entire Contract.
- A. Warranty Duration: As stated in the Conditions of the Contract for Construction or, if not stated, then **one year from Date of Substantial Completion.**
- B. Consequential Damages and Work: The Comprehensive Total Contract Warranty shall include all consequential damages including, without limitation:

1. All work to uncover, repair, restore, and recover work repaired under warranty
  2. All adjacent and related work to provide access to the warranted work
  3. Repair, replacement, and restitution of property damaged by failure of warranted work.
- C. Warranty Claims During Comprehensive Total Contract Warranty: The Owner will notify the Construction Manager in writing of each warranty claim. The Construction Manager shall make repairs within 30 days after receipt of Owner's claim, unless preapproved by the Owner.
- D. Construction Manager's Obligation During the Comprehensive Total Contract Warranty: At no additional cost to the Owner, the Construction Manager shall:
1. Notify in writing each affected warrantor and original subcontractor, installer, supplier, if any.
  2. Manage the warranty claim for the Owner's benefit.
  3. Assist the Owner in obtaining warranty satisfaction.
  4. Arrange and manage all warranty related work including work related to consequential damages.
- E. Expiration of Comprehensive Total Contract Warranty: Approximately 30 days prior to expiration of the Comprehensive Total Contract Warranty, the Owner will create a "Warranty Repair List". The Construction Manager shall make all repairs within 30 days after receipt of Owner's list, unless preapproved by the Owner.
- F. Construction Manager's Failure to Perform During Comprehensive Total Contract Warranty: If the Construction Manager fails to remedy work covered by the Comprehensive Total Contract Warranty, the Owner may perform or may hire another entity to perform the warrantor's obligations and the Construction Manager shall reimburse the Owner for the Owner's total costs including without limitation, management costs.

END SECTION 017836 KUA WARRANTIES

**018120 KUA AIR QUALITY**

1. SUMMARY

This section identifies the requirements and procedures for maintaining acceptable air quality during construction and at the beginning of building occupancy phase. Control of indoor air quality, and overall jobsite air quality, during construction, shall be the responsibility of the Construction Manager.

Related Sections:

- 001540 Construction Waste Management
- 230500 Mechanical General Requirements
- 233113 Air Distribution Systems
- 237200 Heat Recovery Units

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		
Product Cut Sheets		
Product Samples		
Mock-ups		
Closeout submittals	X	Building Flush-out Plan

3. PRODUCTS

N/A

4. EXECUTION & QUALITY CONTROL

A. CONSTRUCTION SEQUENCE

- i. Adjust the construction schedule where possible to install porous materials such as insulation, fireproofing, and drywall only after the building envelope is weathertight.
- ii. Adjust the schedule to account for curing time and off-gassing of construction materials/activities. It is important to understand which materials will off-gas or release moisture as they cure and how long that curing will take.
- iii. Install carpeting and furnishings after other interior finishes have cured. VOCs emitted from carpeting or furnishings can adsorb onto unfinished drywall and other porous materials. As a precaution, schedule the painting of walls before carpeting, furnishings, adhesives or other material that may off-gas significant levels of VOCs are installed.
- iv. Provide adequate ventilation during curing period. To aid in curing of interior finishes and other products used during construction and to remove pollutants, proper filtration and adequate ventilation with 100% outside air will be provided. During humid periods or when very high moisture materials are present, significant dehumidification may be required during this curing period. Dedicated ventilation will be used for curing materials that release VOC's.

B. CONTROL AIR POLLUTANT SOURCES

- i. Building materials shall be kept dry to avoid the introduction of moisture into the building interior. This is especially important with porous or absorptive materials, such as insulation, drywall, and wood.
  - ii. Porous materials that have been damaged by moisture shall be discarded or dried thoroughly before installation. Some materials, such as drywall, can be irreparably damaged by water exposure. Others, such as carpet, must be dried out very quickly to prevent risk of mold contamination.
  - iii. Identify, discuss and correct any construction detailing that could lead to moisture intrusion. During construction, be alert for deficiencies that could result in water entry into the building including leakage at roof intersections, poor rain screen details, inadequate drainage at exterior cladding, foundation details, and inadequate defenses against capillary moisture entry through floor and walls.
  - iv. Use low-emitting products to reduce emissions. When choices can be made, products that are low-emitting and odor-free shall be chosen. This applies to products specified by the Architect as well as products purchased on the job site during construction. Review Material Safety Data Sheets to ensure compliance with this requirement and make suggestions for substitutions where possible.
  - v. Avoid tracking pollutants into work area by controlling access to the job site. Material deliveries and construction waste removal, for example, shall be routed around the exterior of the building rather than through the space. Provide rough track-off grates or matting at the entryways to remove moisture and contaminants from workers' shoes. Smoking by construction workers is not allowed inside the building.
  - vi. Protect against construction generated moisture. Drywall taping and painting are significant sources of moisture. Adequate ventilation to eliminate moisture buildup and damage will be provided by the subcontractor, particularly during winter or humid weather.
  - vii. Minimize the transfer of pollutants from work areas into portions of a building nearing completion by maintaining negative pressure in the work area and positive pressure in the occupied space. This pressure differential should be approximately 0.03 inches water gauge (7 Pascal). This will keep the occupied space pressurized, minimizing the entry of contaminants and dust from the construction area.
  - viii. Use an air barrier or pressure differential to isolate areas at different stages of completion. If there is a significant source of dust or VOC emissions in one part of a building while another area is nearing completion, the more finished area shall be protected from contamination using air barriers or pressure differentials, as described above.
- C. HOUSEKEEPING
- i. Minimize accumulation of dust and other contaminants. Construction practices that minimize the production of dust and other contaminants from construction activities shall be used by subcontractors - e.g., use integral dust-collection systems for equipment including but not limited to drywall sanders, cut-off saws, and routers.
  - ii. Indoor cutting or other dust-generating activities should be centralized to areas where clean-up can be carried out easily and contaminants will not be tracked into other areas. Spray painting of water-based latex paints generates dust – temporary ventilation will be used during this time, with fans blowing directly out through window openings.

- iii. Suppress dust by using environmentally safe wetting agents or sweeping compounds to keep dust from becoming airborne.
- iv. Clean up dust. Wet rags, damp mops, and vacuum cleaners with high-efficiency particulate (HEPA) filters will be used to clean up dust generated by construction activities. These practices are much more effective than sweeping and conventional vacuuming. Increase cleaning frequency when dust accumulation is noted.
- v. Clean up spills. Spills and excess applications of solvent-containing products shall be cleaned up immediately. Water spills shall be mopped up as soon as practicable.
- vi. Keep work area dry. The entire work area will be kept as dry as possible by fixing leaks that allow rainwater entry, mopping up water accumulation, and minimizing use of unvented combustion (e.g., propane or diesel “salamander” space heaters). Dehumidification shall be used when relative humidity exceeds manufacturer’s recommendation for interior materials and finishes.
- vii. Seal containers of volatile liquids. Containers of fuel, paint, finishes, and solvents shall be kept tightly sealed and stored outside the building when not in use. (Water-based materials storage inside is acceptable in tightly sealed containers.)
- viii. Keep construction materials out of spaces nearing completion. Do not allow construction materials, demolition debris, supplies, or tools to be stored in, or transported through, completed or nearly completed portions of the building. Where moisture conditions exist, relative humidity should be monitored to limit the possibility of moisture damage.

**D. HVAC SYSTEMS PROTECTION**

- i. Store HVAC equipment in a clean, dry location or covered with plastic to ensure that equipment is protected from moisture, dust or other contaminants.
- ii. To prevent construction dust from contaminating ductwork, HVAC system should not be used during construction.
- iii. Seal all HVAC inlets and outlets during construction. These include outside air inlets, grills, diffusers, supply ducts, return ducts, ceiling plenums, and VAV plenum intakes. Seal openings with plastic and tape that can be removed cleanly.
- iv. Seal HVAC components during installation. For ducting runs that require several days to install, sections will be sealed off as they are completed, and seals removed prior to continuing the ducting run. The same requirement applies to other components of the HVAC system - do not wait until the system is completed to protect it from contamination.
- v. Use a temporary ventilation system during construction when required that introduces outside air and ventilates contaminated air directly such as an indirect fired makeup air unit. Window-mounted fan units can serve this purpose in small projects. This will apply when material that releases volatile organic compounds (VOCs), odors, or dust is installed, used, or applied.

**E. FLUSH OUT PERIOD**

- i. See Mechanical specifications for building flush out requirements. Recommended: two weeks - prior to occupancy.
- ii. Flush out period prior to occupancy to be coordinated with owner, Construction Manager and mechanical contractor. Recommended flush out period = 2 weeks.

END SECTION 018120 KUA AIR QUALITY

**018140 KUA SUBSURFACE CONDITIONS**

1. SUMMARY

This section provides supplemental information about subsurface conditions and safe digging protocols.

Related Sections:

This section applies to all drawings and specifications included in the construction documentation, including General Requirements.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings		-
Product Cut Sheets		-
Product Samples		
Mock-ups		
Closeout submittals		

3. PROCEDURES

A. The Owner retained a Geotechnical Engineer to explore the subsurface conditions using soil borings.

B. Geotechnical Report

1. A report of Subsurface Exploration and Geotechnical Analysis is included here in the Project Manual Appendix. The report defines the soil bearing conditions at various locations on the site, including adjacent to the existing building foundation.
2. This report is considered supplemental information to the bidders. It is understood that neither the Architect, Engineer, nor the Owner will be responsible for any interpretations or conclusions drawn therefrom by the Bidder with regard to the interpretive data or geotechnical report.
3. Factual subsurface information (test pit logs) has been included as part of the Geotechnical Report. The logs describe subsurface conditions encountered at the exploration locations at the time explorations were made. Actual subsurface conditions may vary due to conditions not evident at the time explorations were made, and therefore no warranties, expressed or implied, are made as to accuracy of subsurface information provided herein, including continuity of strata between exploration locations.
4. Bidders shall make their own deductions of subsurface conditions which may affect means and methods of construction.



5. See the structural drawings and specifications for project requirements related to foundations bearing on soil.

C. Dig Safely

1. Notify appropriate utility companies and municipal departments prior to excavation.
2. The Construction Manager and/or subcontractor shall contact Dig Safe a minimum of 48 hours (excluding weekends and holidays) before any excavation or earth penetration activities have been scheduled. Failure to do this will make the Contractor liable for any and all costs associated with a utility disruption.
3. The Contractor shall follow all Dig Safe rules and is encouraged to photograph markings before digging to document the marked conditions.

END SECTION 018140 KUA SUBSURFACE CONDITIONS

## 019113 MEP COMMISSIONING REQUIREMENTS

### 1. GENERAL

#### A. Summary

- i. This section includes commissioning requirements for HVAC systems, assemblies and equipment.
- ii. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

#### B. Related Sections:

- i. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS.
- ii. All sections relating to the Systems to be Commissioned are related to the commissioning requirements and process. This includes, but is not limited to:
  - a. Division 3 - Concrete
  - b. Division 7 - Flashing of Mechanical Work passing through various control layers
  - c. Division 9 - Finishes (esp. painting)
  - d. Division 20 - Mechanical Support.
  - e. Division 21 - Fire Suppression
  - f. Division 22 - Plumbing
  - g. Division 23 - Heating Ventilating and Air Conditioning
  - h. Division 25 - Integrated Automation
  - i. Division 26 - Electrical
  - j. Division 27 - Communications
  - k. Division 31 - Excavation and Backfill

#### C. Related Documents:

- i. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- ii. OPR and BoD documentation are included by reference for information only.
- iii. Commissioning pertains primarily to the work described in Divisions 22, 23, and 26 and shall be included for all systems to be commissioned as specified herein.
- iv. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
- v. The requirements of Section 23 0500 govern the work specified in this Section, where applicable.

#### D. Systems to be Commissioned:

- i. Commissioning of the HVAC systems shall include all equipment and components associated with the Heating, Ventilation, Air-Conditioning and Refrigeration systems. These shall include:
  - a. All air-side components, including Heat Pump Systems, Fan Coil Units, Heat Recovery Units, Pumps, Coils, Heaters, Dampers, Ductwork, Diffusers and Filters, VRF Heat Pumps, Domestic Water Heaters.
  - b. All water-side components, including Pumps, Piping, Valves, Tanks and Strainers

- c. All central heating and cooling plant components, including Boilers, Drains and Pumps.
- d. All controls, including operator stations, displays, alarms, sensors and control systems programming.

**E. Definitions**

- i. Retain definition(s) remaining after this Section has been edited.
- ii. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor.
- iii. BoD: Basis of Design: A document, prepared by Architect, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines.
- iv. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- v. Prefunctional Check-out Documents and Prefunctional Checklists – checklists developed by the CxA, completed by the contractor and verified by the CxA.
- vi. Contractor: the prime contractor identified in the Contract for Construction between Owner and Contractor. This may be a General Contractor, a Construction Manager or some other entity.
- vii. Corrective Action– documentation of an issue identified by the CxA in a Field Report that requires correction and response by the Contractor.
- viii. CxA: Commissioning Authority.
- ix. Engineering Professionals: Includes the Engineers identified in the Contract for Construction between Owner and Contractor, responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.
- x. Functional Performance Testing – the rigorous, documented testing of systems. Tests are developed by the CxA and performed by the Contractor under the supervision of the CxA.
- xi. CxAlloy<sup>®</sup> Commissioning Construction Issues – log of all CxA identified issues and their status.
- xii. OPR: Owners Project Requirements: A written document, prepared by Owner that details the functional requirements of Project and expectations of how it will be used and operated. This document includes Project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.
- xiii. Subcontractor: contractors responsible to the Contractor or Owner for installation of Systems to be Commissioned.
- xiv. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.
- xv. Systems to be Commissioned: includes all systems, subsystems and equipment and associated components to be commissioned.
- xvi. TAB: Testing, Adjusting, and Balancing.

**F. Commissioning team**

- i. The Commissioning Team is organized and lead by the CxA with the support and coordination of the Contractor. Members include:

- ii. Representatives of the CxA.
  - iii. Representatives of the Owner including facility users and operation and maintenance personnel.
  - iv. Architect and engineering design professionals.
  - v. The Contractor Project Manager, Superintendent and other appropriate parties responsible for coordination of other Division activities.
  - vi. Subcontractor representatives including the project manager and foreman responsible for installation of systems to be commissioned including, but not limited to:
    - a. Mechanical
    - b. Controls
    - c. Plumbing
    - d. Electrical
    - e. TAB
  - vii. Subcontractor appointed training liaisons.
- G. Contractor's Responsibilities
- i. Identify one member of the contractor's team who will act as the primary point of contact for the CxA.
  - ii. Provide utility services required for the commissioning process. This includes ensuring the equipment necessary to access the CxAlloy<sup>®</sup> commissioning website is available on the construction site. This access needs to be provided during construction activities to ensure on site completion of commissioning documentation.
  - iii. Access and utilize the CxAlloy<sup>®</sup> online commissioning software for documentation of commissioning activities.
  - iv. Coordinate subcontractor commissioning activities; ensuring all affected trades are provided with the documentation necessary for the completion of their commissioning scope.
  - v. Provide the CxA with a detailed and accurate construction schedule updated monthly. Coordinate scheduling of commissioning activities with the CxA and include them in the construction schedule.
    - a. Provide schedule for equipment submittals, installation manual submittals, operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule monthly throughout the construction period.
    - b. Coordinate the regular submission of detailed Subcontractor Schedules to the CxA.
  - vi. Provide CxA with copies of all approved change-orders or other modifications impacting construction when approved.
  - vii. Process and respond to Commissioning Construction Issues, Field Reports and RFIs from the CxA. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
  - viii. The Contractor has primary responsibility for ensuring commissioning activities are successfully completed by the subcontractors in a timely manner. In order to fulfill

that responsibility the contractor shall assist the CxA in coordination and execution of all Construction Phase Commissioning Activities including, but not limited to:

- a. Planning and participation in construction-phase coordination meetings.
- b. Planning and participation in commissioning verifications.
- c. Coordination of submittal responses and resubmissions to ensure that resubmissions adequately address design team and CxA comments.
- d. Ensure accurate completion of Prefunctional Checklists for all Systems to be Commissioned **prior** to verification site visits by the CxA.
- e. Certify readiness of Systems to be Commissioned and ensure accurate completion of Functional Performance Test documents **prior** to performance of Functional Performance Testing.
- f. Facilitate Functional Performance Testing of Systems to be Commissioned and participate in testing at the request of the CxA or responsible Subcontractor.
- g. Facilitate operation and maintenance training planning, verification of training, and development of associated documentation for operations and maintenance transition.
  1. Ensure that the CxA-provided training documentation is completed for all training on systems to be commissioned.
- h. Manage the documentation of commissioning work by the sub-contractors.
- i. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
- j. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
- k. Track and follow-up on outstanding corrective action items as follows:
  1. All responses shall be made in the CxAlloy<sup>®</sup> Commissioning Construction Issues provided by Cx Associates via the online platform CxAlloy<sup>®</sup>.
  2. Issues shall be addressed and responses provided within two weeks after they are identified.
  3. Where an issue will take longer than two weeks to address, provide a completion date within two weeks of issue identification.
  4. Resolve all issues within one month of substantial completion.
- ix. Subcontractors shall assign representatives with expertise and authority to act on behalf of the entity responsible for installation of Systems to be Commissioned who shall participate in and perform commissioning team activities including, but not limited to, the following:
  - a. Provide schedules for equipment and system submittals including: submittal information for all Systems to be Commissioned, installation manuals, and operation and maintenance submittals; equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a monthly basis throughout the construction period.
  - b. Participate in construction-phase coordination meetings.
  - c. Process and respond to Commissioning Construction Issues, Field Reports and RFIs from the CxA via the CxAlloy<sup>®</sup> commissioning website.
  - d. Provide information to the CxA for developing construction-phase commissioning plan including, but not limited to: schedule as cited above,

equipment submittals, installation manual submittals and operation and maintenance information submittals.

- e. Complete Prefunctional Checklists for all Systems to be Commissioned in a progressive manner. This entails completing checksheets as the work proceeds – bi-weekly submittal of completed checksheets shall be provided to the CxA via CxAlloy<sup>®</sup> throughout MEP fit-up and equipment installation work.
- f. Participate with the CxA during field verification of contractor completed checklists.
- g. Schedule manufacturer start-up to include completion of commissioning documentation relative to equipment. Schedule manufacturer representative to be on site during the commissioning verification of start-up documentation and functional testing of equipment set up by Manufacturer representatives including but not limited to equipment specific controls, equipment specific VFDs, emergency generators, etc.
- h. Maintain updated Project Record Documents for periodic review of the CxA and submit final record documents at project completion.
- i. Certify readiness of Systems to be Commissioned for performance of Functional Performance Testing.
- j. Complete Functional Performance Tests documents via the CxAlloy<sup>®</sup> commissioning website.
- k. Perform Functional Performance Testing of Systems to be Commissioned under the direction of the CxA.
  - 1. Provide technicians who are familiar with the construction and operation of installed systems, are trained in the use of required testing instruments and procedures to participate in testing of installed systems, subsystems, and equipment.
- l. Designate an Operations and Maintenance Liaison who will have direct responsibility for training planning and execution.
  - 1. Provide operation and maintenance planning, documentation and verification.
  - 2. Provide training sessions for Owner's operation and maintenance personnel.
- x. Use of Online or Digital Platform:
  - a. Use of CxAlloy<sup>®</sup>
    - 1. The contractor shall use CxAlloy<sup>®</sup>, an online commissioning platform, as directed by the CxA and as outlined in the Cx Plan. Any equipment necessary for accessing this online tool shall be provided by the contractor on the construction site. CxAlloy<sup>®</sup> will be used for Pre-functional checkout, functional performance testing, and responding to items in the Commissioning Construction Issues.
    - 2. A Starting Guide for how to use CxAlloy<sup>®</sup> can be found here: [https://s3.amazonaws.com/helpscout.net/docs/assets/58a201fddd8c8e56bfa7a917/attachments/58c04a012c7d3a576d35c9df/Getting\\_Started\\_Team\\_Member.pdf](https://s3.amazonaws.com/helpscout.net/docs/assets/58a201fddd8c8e56bfa7a917/attachments/58c04a012c7d3a576d35c9df/Getting_Started_Team_Member.pdf)
- xi. The ATC Contractor will be responsible for establishing any points and trending required for commissioning purposes, including but not limited to, functional performance testing. The ATC Contractor will:

- a. Review the BAS and submeters to establish which systems will be monitored and trended.
  - b. Identify acceptable ranges for data points and meter values.
  - c. Identify any necessary action for excursions from the acceptable ranges.
  - d. Verify that the BAS data storage capacity is capable of the determined points to be tracked and frequency and duration of monitoring.
  - e. Ensure that the monitored points and trending align with the commissioning schedule's systems.
  - f. Collaborate with the CxA to ensure that monitoring and trending are covering identified operational issues.
  - g. Develop a reporting method in collaboration with the CxA and Facility Operation and Management (FO&M) personnel.
- H. Commissioning Submittals By Contractor
- i. Commissioning-specific submittals:
    - a. The contractor shall submit completed Prefunctional Checklists and Functional Performance Test Documents via the CxAlloy<sup>®</sup> commissioning website.
    - b. The contractor shall submit completed training plans upon approval of submitted equipment.
    - c. The contractor shall submit preventive maintenance plan upon approval of submitted equipment.
    - d. The contractor shall submit control device calibration schedule upon approval of the controls submittal.
  - ii. Commissioning related requirements for submittals on Systems to be Commissioned: The following information shall be submitted with the product and system product literature and shop drawing submittals for review and approval by the Owner, Architect, Engineering Professionals and the CxA.
    - a. Manufacturer cut sheets and product literature and shop drawings in accordance with the requirements of other Divisions.
    - b. Motor enclosure types and efficiencies designated as NEMA Nominal Efficiency and expressed as a percentage.
    - c. Detailed product data for each piece of equipment including part load capacities (20, 40, 60, 80, 100%), electrical components and requirements, etc. (as appropriate).
    - d. Manufacturer's certified test reports on each piece of equipment.
    - e. Performance curves for each piece of equipment being submitted (20, 40, 60, 80, 100% as appropriate).
    - f. Controls submittals shall include:
      - 1. Logic flow diagrams for control systems sequences of operation.
      - 2. Diagrams indicating location of all sensors, actuators, safeties and other control devices for all Systems to be Commissioned.
      - 3. Detailed Sequences of Operation for all Systems to be Commissioned.
      - 4. Control diagram graphic panels for use with DDC PC monitor, in color.
      - 5. Abbreviations and Symbols List.
      - 6. All initial setpoints, reset schedules, time delays, etc. using numerical values.

7. Calibration certificates for all required test instruments demonstrating compliance with Part 2 of this section and any additional requirements of Divisions 22, 23 and 26.
- g. Submit Final Approved Shop Drawings for each piece of equipment to be Commissioned including all “as noted” comments in the final submittal.
- h. TAB plan including equipment to be used as well as methods and strategies to accomplish TAB where system diversity is present.
- iii. The CxA will provide a single review of the submittals. Failure to incorporate agreed upon CxA review comments in subsequent submittals will result in a charge back to the contractor for additional submittal review time.
- iv. Approved submittals for all Systems to be Commissioned must be compiled and individually bookmarked in the navigation pane of a single PDF document, which shall be electronically transferred to the CxA via email or an online file transfer service.
- v. Progress submittals of completed prefunctional checksheets
  - a. Contractor shall be responsible for notifying CxA via email of when contractors will be completing or have completed a majority of the CxAlloy® prefunctional checklists for each equipment type.
  - b. These email notifications shall be provided bi-weekly once fit-up and equipment installation for the affected subcontracts commences and the checksheets have been provided by the CxA.
  - c. The contractor shall submit a schedule for checksheet completion, submittal and verification to assist the team in ensuring that the commissioning process is incorporated as construction progresses.
- vi. Manufacturer Start-up Information
  - a. Manufacturer’s detailed installation and start-up requirements including equipment checklists (manufacturer’s installation, startup, etc.) for each piece of equipment shall be submitted to the CxA within two weeks of when equipment arrives on site.
  - b. Submit manufacturer start-up information prior to starting equipment.
- vii. Detailed Project Training Plans (see Section 3.5 for a complete list of requirements.).
- viii. Operation and Maintenance Manual shall include the following:
  - a. Submit O&M Manual as a single PDF document for each division. Clearly identify the Client and Project Name and the specific contents of each PDF document.
    1. Provide a Table of Contents in each PDF document clearly indicating where information is located.
    2. Bookmark each section and subsection in the PDF document’s navigation pane.
    3. Begin with a “Preventative Maintenance Plan” that includes maintenance instructions with timeframe/frequency for each task for all applicable equipment included in the O&M Manual.
    4. Each subsequent section shall address individual pieces of equipment and be clearly labeled as such. Subsections shall be comprised of specific information for each piece of equipment as listed below.
    5. Operations and Maintenance Manuals shall be fully customized to the project and shall include only product information which is specific and relevant to the project.



- b. All submittal information indicated in part A.iii., A.iv., and B of this section (above) shall be included in the operations and maintenance manual, compiled as subsection per piece of equipment and bookmarked, in addition to the information required below.
    - 1. Manufacturer’s break-in instructions.
    - 2. Manufacturer’s suggested service requirements.
    - 3. Spare parts list edited for specific equipment used on the project.
    - 4. Copy of all equipment specifications.
    - 5. Troubleshooting guide.
    - 6. Controls calibration checklist.
  - ix. Provide all warranties for each division as a single PDF file, bookmarked by equipment name in the navigation panel. Equipment Warranties, contractor, manufacturer and owner obligations to maintain the warranty shall be specifically stated.
  - x. Coordination and Record Drawings.
- I. Quality Assurance
- i. Calibration of Test Equipment: Comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated by NIST traceable standards within six months prior to use.
- J. Systems To Be Commissioned
- i. The following systems will be commissioned in this project.
    - a. HVAC
      - 1. Air Handling Units
      - 2. Heat Recovery
      - 3. Exhaust Fans
      - 4. Heat Exchanger(s)
      - 5. Terminal Units
      - 6. VFDs
      - 7. Controls
      - 8. Heating System
      - 9. Cooling System
    - b. Plumbing
      - 1. Domestic water system
      - 2. Domestic hot water system
      - 3. Plumbing recirculation & booster pumps
      - 4. Plumbing VFDs controls
    - c. Electrical
      - 1. Lighting and lighting control systems
      - 2. Electrical Distribution

2. PRODUCTS

A. TEST EQUIPMENT

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- i. All testing equipment required to perform startup, checklist verification and functional performance testing shall be provided by the contractor responsible for the equipment being tested.
  - ii. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in this Section.
  - iii. All testing equipment calibration shall be:
    - a. NIST traceable standards.
    - b. Maintained in good repair and operating condition throughout the duration of use on this project .
    - c. Recalibrated/repared if dropped or damaged in any way since last calibration.
  - iv. Test instrumentation shall meet the following standards:
    - a. Immersion temperature measuring instruments, liquids:
      1. Range, 0 F to 220 F
        - a. Minimum accuracy, +/- .5 degree F
        - b. Resolution, .1 degree F
    - b. Air temperature measuring instruments:
      1. Range, 0 F to 220 F
        - a. Minimum accuracy, +/- .5 degree F
        - b. Resolution, .1 degree F
    - c. Air humidity measuring instruments:
      1. Range, 0 % RH to 80 % RH
        - a. Minimum accuracy, +/- 2 % RH
        - b. Resolution, .1 % RH
      2. Range, 80 % RH to 97 % RH
        - a. Minimum accuracy, +/- 3 % RH
        - b. Resolution, .1 % RH
    - d. Carbon Dioxide (CO<sub>2</sub>) measuring instruments:
      1. Range, 0 ppm to 2,000 ppm
        - a. Minimum accuracy, +/- 50 ppm
        - b. Resolution, 1.0 ppm
    - e. Carbon Monoxide (CO) measuring instruments:
      1. Range, 0 ppm to 500 ppm
        - a. Minimum accuracy, +/- 2 ppm
        - b. Resolution, .1 ppm
    - f. Hydronic pressure measuring instruments:
      1. Range, 0 PSI to 150 PSI
        - a. Minimum accuracy, +/- .5 PSI
        - b. Resolution, .1 PSI
    - g. Air differential pressure measuring instruments:
      1. Range, 0 "w.c. to 10" w.c.
        - a. Minimum accuracy, +/- .001 " w.c.
        - b. Resolution, .001 " w.c.
    - h. Air velocity measuring instruments:
      1. Range, 25 fpm to 2400 fpm
        - a. Minimum accuracy, +/- 15 fpm
        - b. Resolution, 1.1 fpm
      2. Range, 2400 fpm to 5000 fpm

- a. Minimum accuracy, +/- 30 fpm
- b. Resolution, 1.0 fpm
- i. For instruments not covered above, the following minimum requirements apply:
  - 1. Test instruments shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the previous six months to NIST traceable standards.
- v. Test Ports:
  - a. Pressure / temperature test plugs to allow the use of insertion-type, hand held gauges and meters:
    - 1. Housing: Brass
    - 2. Core Material: EPDM (Nordel)
    - 3. Provide cap retainer strap
    - 4. Size: 1/4" NPT
    - 5. Length: All pipes, insulated or not: maximum 1-1/2" overall
  - b. Acceptable Manufacturers:
    - 1. Texas Fairfax Company
    - 2. Peterson Equipment Company
    - 3. Alternate product with prior approval

### 3. EXECUTION & QUALITY CONTROL

#### A. COMMISSIONING CONSTRUCTION ISSUES AND FIELD REPORTS

- i. CxA maintains Commissioning Construction Issues on the online platform CxAlloy<sup>®</sup> that describes design, installation, and performance issues that are at variance with the OPR, BoD, and Contract Documents.
- ii. The CxA will document any deficiencies observed during construction, checkout and/or testing in a Field Report via the CxAlloy<sup>®</sup> commissioning website. Each Corrective Action will be summarized in the CxAlloy<sup>®</sup> Commissioning Construction Issues on CxAlloy<sup>®</sup>. Contractors remedy and document the correction to the CxA. The CxA will verify corrections depending on their scope and scale.
- iii. The CxA will identify any design related issues in RFIs which will be submitted to the Contractor for processing and tracking.

#### B. PREFUNCTIONAL CHECKLISTS

- i. General. Each piece of equipment receives full prefunctional check-out by the responsible contractor. No sampling strategies are used. The prefunctional check-out protocol for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- ii. Prefunctional Checklists: The CxA provides Prefunctional Checklists for each System to be Commissioned via the online platform CxAlloy<sup>®</sup>. Prefunctional Checklists will be completed by the installing Subcontractor and verified by the Contractor and CxA in the company of the installing contractor. Each checklist will include, but not be limited to, the following:
  - a. Name and identification information of each item being checked.
  - b. Verification of each item including verification of all required data and construction practices as listed in the Prefunctional Checklists.
  - c. Notation of any equipment or installation that deviates from approved submittals or the Construction Documents.

- d. Name(s) of personnel involved with verification and dates on which verification activities and Prefunctional Checklists were completed. The activity’s timestamp and the name of the logged-in user will be automatically recorded via the internal audit log of the CxAlloy® platform when items are completed.
- iii. Checklists are provided for specific pieces of equipment and may require check-out and verification by multiple sub-contractors. (For instance, the electrical contractor is required to complete portions of the checklists for all powered mechanical equipment.) The documents will be assigned to the affected trades as appropriate. Each subcontractor shall be responsible for the checkout and verification of their work. The Contractor shall ensure each required subcontractor has completed their work.
  - a. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off.
- iv. Contractor shall provide a full start-up plan for each system to be commissioned including all subsystems, equipment and components which shall at a minimum include the following documentation:
  - a. Manufacturer’s standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
  - b. Manufacturer’s normally used field checkout sheets.
  - c. The subcontractors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up checklists. Prefunctional checklists completion shall be monitored via the CxAlloy® commissioning website. Contractor to provide email notification to the CxA when startup is completed.
- v. Contractor shall verify 100% of all devices and equipment on the Prefunctional Checklists. Sampling is not acceptable.
- vi. Completion of prefunctional checksheets via the CxAlloy® commissioning website shall occur as the installation progresses. Commissioning verification of checksheets shall be scheduled based on bi-weekly notification via email of completed or partially completed prefunctional checksheets by the subcontractors.
- vii. Sensor Calibration
  - a. Calibration of all sensors shall be included as part of the prefunctional checklists.
  - b. Sensor Required Tolerances listed below shall be the criteria for acceptance. The following are default criteria, subject to revision based on accuracy of final approved and installed devices.

<u>Sensor</u>	<u>Required Tolerance (+/-)</u>	<u>Sensor</u>	<u>Required Tolerance (+/-)</u>
Cooling coil, chilled and condenser water temps	0.3F	Flow rates, water	4% of design
AHU wet bulb or dew point	1.0F	Lighting Illumination	3% of design

## KUA Kilton/Welch Dormitories & Faculty Residences

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Hot water coil and boiler water temp	1.0F	Combustion flue temps	5.0F
Outside air, space air, coil air temps	0.5F	Oxygen or CO <sub>2</sub> monitor	0.1 % pts
Watt-hour, voltage & amperage	1% of design	CO monitor	0.01 % pts
Pressures, air, water and gas	3% of design	Natural gas and oil flow rate	1% of design
Flow rates, air	10% of design	Steam flow rate	3% of design
		Barometric pressure	0.1 in. of Hg

- viii. The CxA will verify prefunctional checklists for each piece of primary equipment in the company of the responsible subcontractors.
  - ix. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CxA shall observe a sampling of the prefunctional check-out and start-up procedures.
- C. FUNCTIONAL PERFORMANCE TESTING
- i. Prerequisites for Testing:
    - a. Systems to be Commissioned have been completed, calibrated, and started; are operating according to the OPR, BoD, and Contract Documents;
    - b. Instrumentation and controls associated with the Systems to be Commissioned have been completed and calibrated; are operating according to the OPR, BoD, and Contract Documents; and that pretest set points have been recorded.
    - c. TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
    - d. Prefunctional Checklists for systems, subsystems, and equipment are completed via the CxAlloy<sup>®</sup> commissioning website and verified.
    - e. Perform Pretest procedures including:
      - 1. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
      - 2. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.
      - 3. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable or failed. Repeat this test for each operating cycle that applies to system being tested.
      - 4. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
      - 5. Annotate checklist or data sheet via the CxAlloy<sup>®</sup> commissioning website when a deficiency is observed.
    - f. Verify equipment interface with monitoring and control system and TAB criteria; include the following:
      - 1. Supply and return flow rates for variable flow and constant volume systems in each operational mode, including maximum and minimum flow/capacity.

2. Operation of terminal units in both heating and cooling cycles.
3. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
4. Building pressurization.
5. Total exhaust airflow and total outdoor-air intake.
6. Operation of indoor-air-quality monitoring systems.
- g. Verify proper responses of monitoring and control system controllers and sensors to include the following:
  1. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
  2. Report deficiencies and prepare a construction issue entry on CxAlloy<sup>®</sup>.
- h. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load indicated in BoD. Operational modes may include the following:
  1. Occupied and unoccupied.
  2. Full load and minimum load.
  3. Maximum flow and minimum flow.
  4. Warm up and cool down.
  5. Economizer cycle.
  6. Emergency power supply.
  7. Life-safety alarm modes.
  8. Temporary upset of system operation.
  9. Partial occupancy conditions.
  10. Special cycles.
- ii. Objectives and Scope.
  - a. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
  - b. In general, each System to be Commissioned should be operated through all modes of operation where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.
- iii. Functional Performance Test Documents:
  - a. The CxA will develop Functional Performance Test Documents through the web-based platform CxAlloy<sup>®</sup> for each System to be Commissioned including:
    1. Name and identification code of each item being checked.

2. Test number.
  3. Time and date of test.
  4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
  5. Dated signatures of the person performing test and of the witness.
  6. Individuals present for test.
  7. Deficiencies.
  8. Issue number, if any, generated as the result of test.
  9. Calibration of sensors and sensor function.
  10. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
  11. Control sequences for mechanical and electrical systems.
  12. Responses to control signals at specified conditions.
  13. Sequence of response(s) to control signals at specified conditions.
  14. Electrical demand or power input at specified conditions.
  15. Power quality and related measurements.
  16. Expected performance of systems, subsystems, and equipment at each step of test. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
  17. Interaction of auxiliary equipment including interfaces and interlocks.
  18. Separate entries will be provided for each item to be tested.
  19. Separate tests will be provided for each mode of operation.
- b. The CxA will witness and document the results of functional performance tests using the specific procedural forms, accessible via the CxAlloy<sup>®</sup> commissioning website, developed for that purpose on CxAlloy<sup>®</sup>.
  - c. Reports will include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
  - d. Data sheets for each controller verifying proper operation of the control system, the system it serves, the service it provides, and its location will be provided.
- iv. Test Methods.
- a. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's graphic trend log capabilities.
  - b. Simulated Conditions.
    - a) Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
  - c. Overwritten Values.
    1. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible.
  - d. Simulated Signals.

1. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
- e. Altering Setpoints.
  1. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable.
- f. Indirect Indicators.
  1. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses.
- g. Perform tests using design conditions whenever possible and where required.
- h. Setup.
  1. Each function and test shall be performed under conditions that simulate actual conditions to the closest practical approximation.
  2. The Contractor executing the test shall provide all necessary materials, system modifications, etc. to produce the flows, pressures, temperatures, etc. necessary to execute the test under specified conditions.
  3. At completion of the test, the Contractor shall return all affected building equipment and systems to their pre-test condition.
- i. Sampling.
  1. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested by the CxA using a sampling strategy.
  2. No sampling is allowed during execution of prefunctional check-out or in contractor provided testing.
  3. The following sampling technique will be applied: 20% Sampling—10% Failure Rule.
    - a. Randomly test at least 20% of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the “first sample.”
    - b. If 10% of the units in the first sample fail the functional performance tests, test another 20% of the group (the second sample).
    - c. If 10% of the units in the second sample fail, test all remaining units in the whole group.
    - d. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible subcontractor to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.
- v. Coordination and Scheduling.
  - a. The subcontractors shall provide sufficient notice to the CxA regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA shall direct, witness and document, via the



CxAlloy® commissioning website, the functional testing of all equipment and systems.

- b. Subcontractors are responsible for execution of all tests.
- c. Functional testing is conducted after prefunctional checklists and startups have been satisfactorily completed. The control system is sufficiently reviewed and approved by the CxA before it is used for TAB or to verify performance of other components or systems.
- d. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems.
- e. Testing proceeds from components to subsystems to systems.
- f. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
- vi. Seasonal Testing & Post Occupancy Verification.
  - a. Subcontractors shall perform seasonal test and opposite seasonal testing for major systems (heating/cooling) that cannot be tested under actual seasonal conditions during construction. Provide opposite season trend logs.
  - b. The controls subcontractor shall participate in opposite season testing and also at least one post occupancy site visit with the CxA.
- vii. Problem Solving
  - a. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems rests with the Contractor, Subcontractors, Architect and Engineering Professionals.
- viii. Trend Logs
  - a. Upon completion of successful functional performance testing, contractor shall submit graphic trend logs to CxA.
  - b. Submit color graphic trend log for each piece of controlled equipment for each controlled parameter.
  - c. Trend logs shall demonstrate successful performance for a seven day period, unless the controlled process requires a longer timeline.
  - d. Trend log color printouts shall be submitted demonstrating successful seasonal performance.
  - e. Provide opposite season trend graphs.
  - f. Trend logs shall be color graphic, with legends, submitted to CxA in color printout form or electronically in .pdf format.
  - g. CxA will recommend acceptance of a specific piece of equipment once the submitted trends are reviewed and approved by CxA.
- ix. Test and Verification Field Reports: CxA will record test data, observations, and measurements within CxAlloy®. Photographs, forms, and other means appropriate for the application shall be included with test documentation. CxA will compile test and verification reports and test and verification certificates and include them in the commissioning report.

**D. NON-CONFORMANCE AND APPROVAL OF TESTS**

- i. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. The CxA is responsible for verification of system installation and function. The CxA will not

overlook deficient work or loosen acceptance criteria to satisfy scheduling or cost issues.

ii. Commissioning Issues

- a. Cx Associates will document all commissioning issues in the Commissioning Construction Issues using the web-based platform CxAlloy<sup>®</sup>. These issues will be updated regularly and always available to the Contractor on CxAlloy<sup>®</sup>. The CxA will notify the applicable parties via email when there are updates to the Commissioning Construction Issues to be addressed.
- b. The responsible contractor shall remedy the issue and update the Commissioning Construction Issue on CxAlloy<sup>®</sup> within two weeks of when the issue is identified.
- c. All open issues shall be closed within one month of substantial completion.
- d. Time & materials required to verify completion of any open commissioning issues one month after the issue was identified and/or one month after substantial completion shall be back charged to the contractor through the Owner.

iii. Non-Conformance.

- a. 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 via the CxAlloy<sup>®</sup> commissioning website.
- b. Should a deficiency be identified during verification or testing, the CxA will discuss the issue with the responsible subcontractor.
  1. When there is no dispute on the deficiency and the subcontractor accepts responsibility to correct it:
    - a. The CxA documents the deficiency and the subcontractor's response and intentions and they go on to another test or sequence.
    - b. After the day's work, the CxA submits the non-compliance reports to the Contractor.
  2. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
    - a. The deficiency shall be documented with the subcontractor's response and a copy given to the Contractor.
    - b. Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the Owner.
  3. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, provides a statement of correction and provides it to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
- c. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, Owner will decide if tests shall be repeated and a revised report submitted.
- d. Cost of Retesting.

1. The cost for the subcontractor to re-perform a prefunctional check-out 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 Owner.
  2. The time for the CxA to direct any re-verification or retesting required due to failures or lack of completion at the initial verification and/or testing, will be back charged to the Contractor through the Owner at 1.5 times the rate for Cx services.
- e. Failure Due to Manufacturer Defect.
1. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the CxA. In such case, the subcontractor shall provide the Owner with the following:
    - a. Within one week of notification from the Contractor, the subcontractor or manufacturer's representative shall examine all other identical units making a record of the findings.
    - b. The findings shall be provided to the CxA within two weeks of the original notice.
    - c. Within two weeks of the original notification, the Contractor, subcontractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals.

*(a) The proposed solutions shall not significantly exceed the specification requirements of the original installation.*
    - d. The Owner will determine whether a replacement of all identical units or a repair is acceptable.
    - e. Two examples of the proposed solution will be installed by the subcontractor and the subcontractor will be allowed to test the installations for up to one week, upon which the Owner will decide whether to accept the solution.
    - f. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.
- f. Approval.
1. The CxA notes each satisfactorily observed checklist item or demonstrated test function on the test form via the CxAlloy®

commissioning website. The CxA recommends acceptance of each test to the Owner using a standard form.

- E. Deferred Testing:
  - i. If tests cannot be completed because of a deficiency outside the scope of the subcontractor responsible for installation of the System to be Commissioned, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.
  - ii. Where seasonal testing is required, appropriate initial performance tests shall be completed, documented, and additional tests scheduled.

4. TEST PORTS

- A. Application: All points.
  - i. The contractor shall provide test ports (Pete’s Plugs) for handheld instrument readings near all piping system sensors in the primary system and for all air system devices.

END SECTION 019113 MEP COMMISSIONING REQUIREMENTS

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## 019119 EXTERIOR ENCLOSURE COMMISSIONING REQUIREMENTS

***THIS FULL SPECIFICATION SECTION REPLACES THE SPECIFICATION SECTION OF THE SAME NAME.***

### 1. GENERAL

#### A. RELATED DOCUMENTS

- i. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- ii. OPR and BoD documentation are included by reference for information only.
- iii. Commissioning Plan – A Preliminary Commissioning Plan is provided as supplemental information and will guide the commissioning process.

#### B. SUMMARY

- i. The purpose of Building Enclosure Commissioning (BECx) is to provide a process for independent, third-party verification that the installed performance of the building exterior enclosure meets or exceeds the minimum performance requirements set forth by the contract documents for this project. The air, thermal, vapor and water leakage control systems will be commissioned to verify functionality, quality of installation and durability of the air, vapor, and water barrier systems.
- ii. This section includes general requirements that apply to requirements and implementation of non-structural commissioning of the building exterior enclosure, without regard to specific systems, assemblies, or components.
- iii. Related Divisions & Documents:
  - a. All sections relating to the Systems to be Commissioned are related to the commissioning requirements and process.
  - b. This includes, but is not limited to all Sections of Divisions 01, 07, and 08 and specific technical specifications found in division 03, 04, and 06 as it pertains to the air, thermal, drainage, and/or vapor barriers. Content in these specifications does not include content pertaining to structural performance and testing, fire-proofing, and interior assemblies
  - c. Section 01 19 13 Commissioning Requirements
  - d. The Building Envelope Commissioning Plan and Appendices

#### C. DEFINITIONS

- i. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor.
- ii. BoD: Basis of Design: A document, prepared by Architect, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines.
- iii. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- iv. Construction Checklists – enclosure material/systems checklists, developed by the CxA, completed/recognized by the contractor, and verified by the CxA.

- v. Contractor: the prime contractor identified in the Contract for Construction between Owner and Contractor. This may be a General Contractor, a Construction Manager or some other entity.
  - vi. Corrective Action– documentation of an issue identified by the CxA in a Field Report that requires correction and response by the Contractor.
  - vii. CxA: Commissioning Authority.
  - viii. Engineering Professionals: Includes the Engineers identified in the Contract for Construction between Owner and Contractor, responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.
  - ix. Field Test Matrix – A detailed table found as an appendix in the Commissioning Plan that compiles all specified enclosure field testing at the time of document creation. This matrix is reviewed by the Architect for accuracy and, if necessary, approval of any added testing clarifications.
  - x. Functional Performance Testing – the rigorous, documented testing of enclosure systems. Tests are specified by the Architect and performed by a 3<sup>rd</sup> party testing agent engaged by either the owner or the contractor, depending on how each test is specified.
  - xi. CxAlloy<sup>®</sup> Commissioning Construction Issues – log of all CxA identified issues and their status.
  - xii. OPR: Owners Project Requirements: A written document, prepared by Owner that details the functional requirements of Project and expectations of how it will be used and operated. This document includes Project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.
  - xiii. Subcontractor: contractors responsible to the Contractor or Owner for installation of Systems to be Commissioned.
  - xiv. Systems, Assemblies, and Materials: Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, and materials.
  - xv. Systems to be Commissioned: includes all systems, assemblies, and associated materials to be commissioned.
- D. COMMISSIONING TEAM
- i. The Commissioning Team is organized and lead by the CxA with the support and coordination of the Contractor. Members include:
    - a. Representatives of the CxA.
    - b. Representatives of the Owner including facility users and operation and maintenance personnel.
    - c. Architect and engineering design professionals.
    - d. The Contractor Project Manager, Superintendent and other appropriate parties responsible for coordination of other Division activities.
    - e. Subcontractor representatives including the project manager and foreman responsible for installation of systems to be commissioned including, but not limited to the following trades:
      - 1. Waterproofing/Damp proofing Systems
      - 2. Wall Air & Vapor Barriers
      - 3. Wall Thermal Barriers
      - 4. Wall Finishes

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5. Roof Systems
  6. Windows/Storefronts/Curtain Walls
  7. Exterior Swing Doors and Overhead Doors
- E. CONTRACTOR'S RESPONSIBILITIES
- i. Identify one member of the contractor's team who will act as the primary point of contact for the CxA and all activities performed by the CxA.
  - ii. Provide utility services required for the commissioning process. This includes ensuring the equipment necessary to access the CxAlloy<sup>®</sup> commissioning website is available on the construction site. This access needs to be provided during construction activities to ensure on site completion of commissioning documentation.
  - iii. Access and utilize the CxAlloy<sup>®</sup> online commissioning software for documentation of commissioning activities.
  - iv. Coordinate subcontractor commissioning activities; ensuring all affected trades are provided with the documentation necessary for the completion of their commissioning scope.
  - v. Provide the CxA with a detailed and accurate construction schedule updated monthly. Coordinate scheduling of commissioning activities with the CxA and include them in the construction schedule.
    - a. Provide schedule for enclosure system submittals and shop drawings for incorporation into the commissioning plan. Update schedule monthly throughout the construction period.
    - b. Coordinate the regular submission of detailed Subcontractor Schedules to the CxA.
  - vi. Provide CxA with copies of all approved drawings, specifications, submittals, shop drawings, manufacturer's literature, schedules, change-orders, ASIs, or other modifications impacting construction when approved.
  - vii. Process and respond to Commissioning Construction Issues, Field Reports and RFIs from the CxA. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system/material installation, and recommend corrective actions.
  - viii. The Contractor has primary responsibility for ensuring commissioning activities are successfully completed in a timely manner. In order to fulfill that responsibility, the contractor shall assist the CxA in coordination and execution of all Construction Phase Commissioning Activities including, but not limited to:
    - a. Planning and participation in construction-phase coordination meetings, including the kick-off meeting.
    - b. Planning and participation in commissioning verifications.
    - c. Coordination of submittal responses and resubmissions to ensure that resubmissions adequately address design team and CxA comments.
    - d. Complete and participate in the construction of on-site mock-ups and the assessment of detail constructability and performance. This includes elements of the building exterior enclosure, as identified in individual sections of the specifications in Divisions 1 through 9 - including but not limited to wall-to-window/storefront/curtain wall interfaces, roof-to-wall interfaces, wall to slab/foundation interfaces, and any penetrations. Provide personnel to be

present and have a representative present from each trade and/or subcontractor associated with installing the system during mock-up performance testing and inspections. If a systemic problem is identified during testing, provide repair and remediation protocol for any systemic failures identified by the Commissioning Authority. Include a timeline for repair of all affected elements. Repaired elements shall not be covered up without review by the Commissioning Authority.

- e. Ensure accurate completion of provided Construction Checklists at critical construction milestones.
- f. Certify readiness of Systems to be Commissioned and ensure accurate completion of Functional Performance Test documents **prior** to performance of Functional Performance Testing.
- g. Facilitate Functional Performance Testing of Systems to be Commissioned and participate in testing at the request of the CxA or responsible Subcontractor.
  1. Ensure subcontractors engage testing agencies, as necessary, in a timely manner in order to incorporate field testing at the appropriate time.  
Note: Subcontractors are responsible for all contractor-engaged 3<sup>rd</sup> party testing as indicated in the project specifications and the Commissioning Plan test matrix.
- h. Provide necessary labor and equipment to facilitate Functional Performance Testing engaged by owner and by contractor. This includes, but is not limited to providing:
  1. Clear access to test locations.
  2. Boom lifts, scissor lifts, scaffolding, swing staging, and/or fork-trucks and operators, as needed, to access and test enclosure systems from the interior or exterior.
  3. Temporary masking of HVAC penetrations and any unfinished openings for blower door tests.
  4. Temporary heated enclosures on the exterior of the building in order to create suitable conditions for wintertime tests.
  5. Temporary enclosures within the building to perform progress tests requiring pressurization of discrete areas.
  6. Accessible 110v power, within 100' of test locations.
  7. Accessible water supply within 300' of test locations capable of delivering at least 30 psi of pressure and equipped with a standard 3/4" hose bibb connection.
  8. Temporary control of HVAC systems controls for testing, as needed for late-stage testing.
  9. Contractor witnesses during testing.
- i. Manage the documentation of commissioning work by the sub-contractors.
- j. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
- k. Provide a Systems Manual for each major building exterior enclosure system as part of the project record closeout documentation. The CxA will provide an outline template for inclusion in the CxA O&M Plan. This should serve as a



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starting point for the contractor-provided systems manual which should include closeout requirements listed in relevant specifications, and more specifically:

1. As-built drawings, including a copy of all details and drawings that were installed as part of any addendums or change order directives. All deviations shall be clearly marked in red.
  2. Specifications for the project, including all accepted product substitutions and any additional specifications as part of any addendums or change order directives. All accepted product substitutions and all deviations shall be clearly marked in red.
  3. A copy of all accepted change orders.
  4. A copy of all final shop drawings for each product requiring shop drawings, with the A/E mark-ups and comments, showing final as-built conditions
  5. A copy of all warranties, organized by product, and any and all product manufacturer letters indicating the product as appropriate to use for the application intended on the project as well as any installation guidance.
  6. A master product list summarizing all products used on the project for construction of the building exterior enclosure, organized by tabs in a binder, including product name, manufacturer, manufacturer contact information, install, installer contact information, product installation and maintenance guides, etc.
- l. Complete the CxA-provided Enclosure System Manufacturer, Installer, and Warranty Appendix outline for inclusion in the CxA's O&M Plan.
- m. Track and follow-up on outstanding corrective action items as follows:
1. Document any and all corrective actions in detail with photo sequences.
  2. Corrective actions requiring modification of construction documents shall be formally approved by the architect and documented.
  3. All responses shall be made in the CxAlloy<sup>®</sup> Commissioning Construction Issues provided by Cx Associates via the online platform CxAlloy<sup>®</sup>.
  4. Issues shall be addressed and responses provided within two weeks after they are identified. Issues at risk of concealment may require faster responses.
  5. Where an issue will take longer than two weeks to address, provide a completion date within two weeks of issue identification.
  6. Resolve all issues within one month of substantial completion.
- n. Subcontractors shall assign representatives with expertise and authority to act on behalf of the entity responsible for installation of Systems to be Commissioned who shall participate in and perform commissioning team activities including, but not limited to, the following:
1. Provide schedules for system and material submittals including: submittal information for all Systems to be Commissioned, shop drawings, and warranty letters manuals for incorporation into the commissioning plan. Update schedule on a monthly basis throughout the construction period.

2. Participation in mock-up construction and performance testing and inspections. Personnel from each trade that will be completing the work in the field are to be utilized to construct each required mock-up.
  3. Participate in construction-phase coordination meetings.
  4. Process and respond to Commissioning Construction Issues, Field Reports and RFIs from the CxA via the CxAlloy<sup>®</sup> commissioning website.
  5. Complete Construction Checklists for all Systems to be Commissioned in a progressive manner. This entails completing/responding to checksheets as the work commences and at the critical progress milestones outlined on the checksheet. Completed checksheets shall be provided to the CxA via CxAlloy<sup>®</sup> throughout construction.
  6. Participate with the CxA during field inspections and functional performance testing.
  7. Document, through photographs, the sequence and overall installation of all major envelope transition details at their first instance, including first instance of each of the control layers (air, thermal, vapor, and drainage layers). Any repair work shall also be documented by the contractor.
  8. Maintain updated Project Record Documents for periodic review of the CxA and submit final record documents at project completion.
  9. Certify readiness of Systems to be Commissioned for performance of Functional Performance Testing.
  10. Complete Functional Performance Tests documents via the CxAlloy<sup>®</sup> commissioning website.
  11. Provide all contractor-engaged 3<sup>rd</sup> party Functional Performance Testing as identified in the project specifications and the test matrix of the Building Enclosure Commissioning plan.
    - a. Installers should be present to witness testing and assess the nature of system failures, if any.
    - b. Provide copies of all 3<sup>rd</sup> party test and inspections reports to the rest of the Commissioning Team immediately upon receipt.
- o. Use of Online or Digital Platform:
1. Use of CxAlloy<sup>®</sup>
    - a. The contractor shall use CxAlloy<sup>®</sup>, an online commissioning platform, as directed by the CxA and as outlined in the Cx Plan. Any equipment necessary for accessing this online tool shall be provided by the contractor on the construction site. CxAlloy<sup>®</sup> will be used for Construction Checklists, Functional Performance Testing, and responding to items in the Commissioning Construction Issues.
    - b. A Starting Guide for how to use CxAlloy<sup>®</sup> can be found here: [https://s3.amazonaws.com/helpscout.net/docs/assets/58a201fddd8c8e56bfa7a917/attachments/58c04a012c7d3a576d35c9df/Getting\\_Started\\_Team\\_Member.pdf](https://s3.amazonaws.com/helpscout.net/docs/assets/58a201fddd8c8e56bfa7a917/attachments/58c04a012c7d3a576d35c9df/Getting_Started_Team_Member.pdf)

**F. COMMISSIONING SUBMITTALS BY CONTRACTOR**

- i. Commissioning-specific submittals:

- a. The contractor shall submit completed Construction Checklists and Functional Performance Test Documents via the CxAlloy® commissioning website.
- ii. Commissioning related requirements for submittals on Systems to be Commissioned: The following information shall be submitted with the product and system literature and shop drawing submittals for review and approval by the Owner, Architect, Engineering Professionals and the CxA.
  - a. Manufacturer cut sheets, product literature, shop drawings, and warranties in accordance with the requirements of other Divisions' submittal articles.
  - b. Qualifications Data: For fabricators, installers, and testing agencies, submit to the Commissioning Authority for review all qualifications required in Divisions 01 through 09 for review.
  - c. Preconstruction Test Reports: All preconstruction test results, including but not limited to: air and water leakage fenestration testing, qualitative air barrier testing, sealant and membrane adhesion testing, etc.
  - d. Source Quality Control (Laboratory Test Reports): Retain a copy for field review by the CxA and include in the closeout submittal a copy of all manufacturer QA/QC reports submitted for products supplied for the project.
    - 1. For window/storefront/curtain wall systems independent test reports shall include air and water penetration testing pressure ratings and leakage tolerances.
  - e. Field Quality Control Reports: Provide a copy of the test reports for all enclosure field testing completed by the testing agency on behalf of the contractor and/or subcontractors.
  - f. Special Inspections Reports: Provide a copy of all special inspections reports for inspections indicated by the Architect/Engineer-of-Record in the specifications.
  - g. Submit Final Approved Shop Drawings for each piece of equipment to be Commissioned including all "as noted" comments in the final submittal.
- iii. The CxA will provide a single review of the submittals. Failure to incorporate agreed upon CxA review comments in subsequent submittals will result in a back charge to the contractor for additional submittal review time.
- iv. Approved submittals for all Systems to be Commissioned must be compiled and individually bookmarked in the navigation pane of a single PDF document, which shall be electronically transferred to the CxA via email or an online file transfer service.
- v. Progress submittals of completed construction checklists.
  - a. Contractor shall be responsible for notifying CxA via email of when contractors will be completing or have completed a majority of the CxAlloy® construction checklists for each system/material type.
  - b. These email notifications shall be provided bi-weekly once material installation of the affected subcontracts commences and the checksheets have been provided by the CxA.
  - c. The contractor shall submit a schedule for checksheet completion and submission to assist the team in ensuring that the commissioning process is incorporated as construction progresses.

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- vi. Provide all warranties for each division as a single PDF file, bookmarked by system name in the navigation panel. System Warranties, contractor, manufacturer and owner obligations to maintain the warranty shall be specifically stated.
  - vii. Coordination and Record Drawings.
- G. **QUALITY ASSURANCE**
- i. Calibration of Test Equipment: Comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated by NIST traceable standards within six months prior to use.
- H. **SYSTEMS TO BE COMMISSIONED**
- i. The following systems will be commissioned in this project.
    - a. Air Barriers (for all major enclosure assemblies)
    - b. Vapor Retarders (for all major enclosure assemblies)
    - c. Thermal Barriers (for all major enclosure assemblies)
    - d. Bulk Water Barriers/Drainage Planes (for all major enclosure assemblies)
    - e. Integration of the above control layers at major system interfaces (ex. wall-to-roof)
2. **PRODUCTS**
- A. **PERFORMANCE REQUIREMENTS**
- i. Testing of Mockups: See requirements for Mock Ups noted in Division 01 and in individual specification sections.
  - ii. Quality Assurance and Compliance Testing during construction: See the BECx Commissioning Plan, its appendices, and all Field Quality Control Requirements that may be found in:
    - a. Sections under Division 01 which relate to the field testing of exterior assemblies and/or mock ups.
    - b. Technical sections under Division 07
    - c. Technical sections under Division 08
  - iii. All testing equipment utilized by the independent testing agency shall be of sufficient quality and accuracy to test and/or measure system performance and shall be within their appropriate calibration period.
3. **EXECUTION**
- A. **COMMISSIONING CONSTRUCTION ISSUES AND FIELD REPORTS**
- i. CxA maintains Commissioning Construction Issues on the online platform CxAlloy<sup>®</sup> that describes design, installation, and performance issues that are at variance with the OPR, BoD, and Contract Documents.
  - ii. The CxA will document any deficiencies observed during construction, checkout and/or testing in a Field Report via the CxAlloy<sup>®</sup> commissioning website. Each Corrective Action will be summarized in the CxAlloy<sup>®</sup> Commissioning Construction Issues on CxAlloy<sup>®</sup>. Contractors remedy and document the correction to the CxA. The CxA will verify corrections depending on their scope and scale.
- B. **CONSTRUCTION CHECKLISTS**
- i. General. Each major system material receives full installation check-out by the responsible contractor. No sampling strategies are used. The installation checklists

for a given material must be completed at commencement of material installation and again at the major milestones of material installation, as identified by the checklists. The intent of these checklists is to notify the CxA of installation commencement and to ensure the responsible contractor has acknowledged and adopted critical installation requirements throughout material installation, while it is still exposed.

- ii. Construction Checklists: The CxA provides Construction Checklists for the performance materials of each System to be Commissioned via the online platform CxAlloy<sup>®</sup>. Construction Checklists will be completed by the Contractor or installing Subcontractor. The CxA will verify components on the checklist through periodic inspections where materials/systems are accessible. Each checklist will include, but not be limited to, the following:
  - a. Name and identification information of each critical installation requirement being checked.
  - b. Contractor or Subcontractor verification of each item including verification of all required data and construction practices as listed in the Construction Checklists.
  - c. Notation of any material/system or installation practice that deviates from approved submittals or the Construction Documents.
  - d. Timely signature from the Contractor or installing Subcontractor at defined installation milestones acknowledging systems/materials are installed per Construction Checklist and Construction Document requirements.
  - e. Name(s) of personnel involved with verification and dates on which verification activities and Construction Checklists were completed. The activity's timestamp and the name of the logged-in user will be automatically recorded via the internal audit log of the CxAlloy<sup>®</sup> platform when items are completed.
- iii. Checklists are provided for specific systems/materials. Depending on the design intent of a given material, checklists may or may not include items pertaining to integration of other systems/materials. Interpretation of scope extent/ownership is not always clear and scope sequencing can occasionally be interchangeable. Because of this, it is possible that CxA inspections will identify and document material continuity/integration issues beyond the extent of the checklists themselves. Such occurrences will generally be assigned to the general Contractor to delegate corrections appropriately and provide a unified response to the CxA. The Contractor shall ensure each required Subcontractor has completed their work.
  - a. Only individuals that have direct knowledge and witnessed that a line item task on the construction checklist was actually performed shall initial or check that item off.
- iv. Contractor shall verify 100% of all systems and materials on the Construction Checklists, to fully represent the entirety of the installation. Sampling is not acceptable.
- v. Completion of Construction Checklists via the CxAlloy<sup>®</sup> commissioning website shall occur as the installation progresses. Commissioning inspections shall be scheduled based on full or partial completion of checklists and/or general communications with the Contractor about installation progress.
- vi. The CxA will verify Construction Checklists for each primary system/material in the company of the responsible subcontractors if possible.

C. FUNCTIONAL PERFORMANCE TESTING

- i. Prerequisites for Testing:
  - a. Functional Performance Testing readiness checksheets for specific test locations have been completed by the Contractor or installing Subcontractor.
    - 1. Exceptions: 1<sup>st</sup> Instance Air Barrier Testing: Given this testing is qualitative, comes with significant flexibility in testing parameters, and is very schedule sensitive, general test visits are usually coordinated with the Contractor and specific test locations and details to be tested are defined on site the day of testing.
  - b. An independent testing agency has been engaged by the Owner and/or the Contractor for the field testing specified in the project specifications and the Commissioning Plan test matrix. Note: The responsibility for engaging enclosure specific testing is identified by the language in the project specifications and Commissioning Plan test matrix.
  - c. Schedule of testing and arrival of the testing agent has been communicated at least 1 week in advance of testing to allow other Commissioning Team members the opportunity to witness testing.
- ii. Objectives and Scope.
  - a. Required Functional Performance Testing for the building enclosure is dictated by the field test standards defined by the owner or architect, with input from the CxA, in the project specifications and compiled in the Commissioning Cx Plan test matrix appendix. In the project specifications, these enclosure field tests standards typically fall under the “Field Quality Control” articles of sections within Divisions 01, 07, and 08. The objective of functional performance testing is to demonstrate that each system requiring testing is performing per the documented design intent and Contract Documents. During the testing process, areas of deficient performance are identified and documented for review and correction, as necessary. When scheduled in a timely fashion, testing can help identify areas of deficiency before systemic faults are implemented and costly or impossible to correct.
- iii. Functional Performance Test Documents:
  - a. The CxA will develop Functional Performance Test Documents through the web-based platform CxAlloy<sup>®</sup> for each System to be Commissioned including:
    - 1. Name and location of each test specimen.
    - 2. Test standard utilized.
    - 3. Test number.
    - 4. Time and date of test.
    - 5. Indication of whether the record is for a first test or retest following correction of a problem or issue.
    - 6. Individuals present for test.
    - 7. Issue number, if any, generated as the result of test.
    - 8. Testing conditions under which test was conducted, including (as applicable) ambient conditions, induced pressures, points, override conditions, and status and operating conditions that impact the results of test.

9. Pass/Fail tolerances for each test.
  10. Test results and any observed deficiencies contributing to any failed tests.
  11. Separate entries will be provided for each item to be tested.
- b. The CxA documents the results of functional performance tests using the specific procedural forms, accessible via the CxAlloy<sup>®</sup> commissioning website, developed for that purpose on CxAlloy<sup>®</sup>.
  - c. The CxA will witness and/or perform testing in-person on an as-needed basis.
- iv. Test Methods.
- a. Required Functional Performance Testing for the building enclosure is dictated by the field test standards defined by the owner or architect, with input from the CxA, in the project specifications and compiled in the Commissioning Cx Plan test matrix appendix. These enclosure field tests standards typically fall under the “Field Quality Control” articles of sections within Divisions 01, 07, and 08.
  - b. Where field testing is required, all performance requirements listed in the contract documents shall be cross-checked against the approved submittal product test data (when available). If the specified test requirements are deemed more stringent than that of the submitted and approved product test data, then the product test data shall govern as it relates to determining appropriate test pressures, tolerances, etc. Otherwise, the specified test requirements and/or the Commissioning Plan test matrix shall stand.
  - c. Where this section, technical specifications and/or the Commissioning Plan test matrix omit test standards, quantities, performance requirements, criteria for satisfactory results, or protocol for non-satisfactory results, or where discrepancies exist between the specifications and the Commissioning Plan test matrix, the Architect-of-Record and CxA should be immediately notified to determine the proper course of action.
- v. Coordination and Scheduling.
- a. The Contractor and Subcontractors shall provide sufficient notice to the CxA regarding their completion schedule for the construction checklists and readiness of systems for Functional Performance Testing. The CxA shall direct, witness and/or perform and document, via the CxAlloy<sup>®</sup> commissioning website, the functional testing of all systems.
  - b. Engaging an independent testing agent for field tests is the responsibility of the Owner and/or the Contractor/Subcontractor depending on how each field test is specified in the project specifications. It is common for specification language to default all testing responsibility to the contractor except where explicitly written as “Owner shall engage”, or similar. The Owner and Contractor shall review project specifications to determine responsibility.
- vi. Problem Solving
- a. When possible, the CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems rests with the Contractor, Subcontractors, Architect and Engineering Professionals.
- vii. Test and Verification Field Reports: CxA will record test data, observations, and measurements within CxAlloy<sup>®</sup>. Photographs, forms, and other means appropriate

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for the application shall be included with test documentation. CxA will compile test and verification reports and include them in the commissioning report.

- a. 3<sup>rd</sup> party test reports shall include measured data, test protocol, test results, and a comprehensive summary describing the specific building exterior enclosure systems at the time of testing.

D. NON-CONFORMANCE AND APPROVAL OF TESTS AND INSPECTIONS

- i. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. The CxA is responsible for verification of system installation and function. The CxA will not overlook deficient work or loosen acceptance criteria to satisfy scheduling or cost issues.
- ii. Test Outcome Protocol:
  - a. Where building enclosure field tests yield results which do not satisfy the performance requirements of the Commissioning Plan test matrix, the product test data, the associated technical specification, and/or the test standard, standard protocol shall be to retest the failed area after corrections have been made and test one additional new area for each failed result – unless otherwise stated for specific tests in the project specifications.
  - b. Where building enclosure field tests yield results which satisfy the performance requirements of the Commissioning Plan test matrix, the product test data, the associated technical specification, and/or the test standard, the results shall be considered acceptable for the project. The enclosure installation subjected to the field test shall be replicated in all similar and applicable locations throughout the building.
  - c. If a deficiency is identified and it is determined that the system is constructed according to the Contract Documents, the Owner will decide whether modifications are required to bring the performance of the system to a level where the failure or deficiency is eliminated and shall be implemented or if the test results will be accepted as submitted. If corrective work is performed, the Owner will decide if tests shall be repeated and a revised report is to be submitted.
- iii. Commissioning Issues
  - a. Cx Associates will document all commissioning issues in the Commissioning Construction Issues using the web-based platform CxAlloy<sup>®</sup>. These issues will be updated regularly and always available to the Contractor on CxAlloy<sup>®</sup>. The CxA will notify the applicable parties via email when there are updates to the Commissioning Construction Issues to be addressed.
  - b. The responsible contractor shall remedy the issue and update the Commissioning Construction Issue on CxAlloy<sup>®</sup> within two weeks of when the issue is identified.
  - c. All open issues shall be closed within one month of substantial completion.
  - d. Time & materials required to verify completion of any open commissioning issues one month after the issue was identified and/or one month after substantial completion shall be back charged to the contractor through the Owner.



- iv. Non-Conformance.
  - a. Corrections of minor deficiencies identified may be made during certain tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented via the CxAlloy<sup>®</sup> commissioning website.
  - b. Should a deficiency be identified during verification or testing, the CxA will discuss the issue with the Contractor or responsible Subcontractor.
    - 1. When there is no dispute on the deficiency and the Contractor/Subcontractor accepts responsibility to correct it:
      - a. The CxA documents the deficiency and the subcontractor's response and intentions and testing and verification progresses.
    - 2. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
      - a. The deficiency shall be documented with the Contractor or Subcontractor's response and a copy given to the Contractor.
      - b. Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the Owner.
    - 3. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, provides a statement of correction and/or clear photo documentation evidence of correction and provides it to the CxA. If necessary, the CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
  - c. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, Owner will decide if tests shall be repeated and a revised report submitted.
  - d. Cost of Retesting.
    - 1. The cost for the subcontractor to re-perform a functional test, if they are responsible for the deficiency and regardless of original ownership, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the Owner.
    - 2. The time for the CxA to direct any retesting required due to failures or lack of completion at the initial verification and/or testing, will be back charged to the Contractor through the Owner at 1.5 times the rate for Cx services.
  - e. Failure Due to Manufacturer Defect.
    - 1. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the CxA. In such case, the subcontractor shall provide the Owner with the following:

- a. Within one week of notification from the Contractor, the subcontractor or manufacturer's representative shall examine all other identical units making a record of the findings.
- b. The findings shall be provided to the CxA within two weeks of the original notice.
- c. Within two weeks of the original notification, the Contractor, subcontractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals.

*(a) The proposed solutions shall not significantly exceed the specification requirements of the original installation.*

- d. The Owner will determine whether a replacement of all identical units or a repair is acceptable.
- e. Two examples of the proposed solution will be installed by the subcontractor and the subcontractor will be allowed to test the installations for up to one week, upon which the Owner will decide whether to accept the solution.
- f. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

v. Deferred Testing:

- a. If field tests cannot be completed because of a deficiency outside the scope of the subcontractor responsible for installation of the System to be Commissioned, the deficiency shall be documented and reported to the Owner and the Architect-of-Record. Deficiencies shall be resolved and corrected by appropriate parties and the test rescheduled.
- b. If field tests cannot be completed because of inclement weather, the testing agency shall notify the commissioning team in advance and coordinate to reschedule testing at the next earliest availability to minimize disruption to project schedule.

END SECTION 019119 EXTERIOR ENCLOSURE COMMISSIONING REQUIREMENTS

**024119 KUA SELECTIVE DEMOLITION**

1. SUMMARY

This section includes information about demolition of the existing exterior framed structures, as well as selective demolition of the plaza level of the existing building.

Both Welch and Kilton existing buildings are historic structures. Special care must be taken in the demolition on any portion of this building.

Related Sections:

011000 Summary and General Conditions

015240 Construction Waste Management

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Demolition sequencing schedule for Owner coordination.
Product Cut Sheets	NA	-
Product Samples	NA	
Mock-ups	NA	
Closeout submittals	X	- Warranty Information

3. PROJECT CONDITIONS

A. OCCUPATION OF BUILDING

- i. Both existing faculty residences will be occupied during construction, although Welch will be vacant during the summer 2023. The first floor of the Kilton dorm may be occupied during the school year 2023-2024. See school academic calendars attached in Appendix.
- ii. Temporary walls and access/egress may be required to separate occupied spaces from construction areas.

B. HAZARDOUS MATERIALS

- i. See associated Environmental Surveys and Remediation proposals.
- ii. Remediation by Owner with the exception of radon mitigation (see drawings) and handling of existing lead paint are by contractor.

C. PHOTO DOCUMENTATION:

- i. Completely photograph all spaces prior to demolition. Provide digital photo files to Owner for record.

4. EXECUTION & QUALITY CONTROL

A. SELECTIVE DEMOLITION SCHEDULE:

- i. See Demolition plans and elevations for notes on preservation of contents.

- ii. See MEP drawings for extent of demolition of building systems.
  - iii. See structural drawings for extent of structural demolition.
  - iv. Prior to start of demolition, the general contractor will present the owner and architect with a proposed schedule for demolition. The schedule shall be presented at least one week prior to demolition.
- B. DISPOSAL:
- i. See Construction Waste Management Plan for requirements around waste disposal.
  - ii. Contractor to provide dumpster for disposal of all materials.
    - a. Location of dumpster to be approved by owner.
  - iii. Provide legal disposal of all demolition materials.
    - a. Provide landfill records for disposal of any hazardous material.

END SECTION 024119 KUA SELECTIVE DEMOLITION

**033300 KUA ARCHITECTURAL CAST-IN-PLACE CONCRETE**

1. SUMMARY

This section includes sealing exterior and interior concrete and surface treatment of exterior exposed concrete surfaces.

Related Sections:

- 015000 Temporary Facilities and Controls
- 033000 Cast-In-Place Concrete (Structural)
- 071900 Concrete Sealer
- 079100 Movement Joints and Sealants

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	<ul style="list-style-type: none"> <li>- Diagram defining locations of control joints and saw cutting of slabs</li> <li>- Panel layout drawing for exposed surface concrete</li> </ul>
Product Cut Sheets	X	<ul style="list-style-type: none"> <li>- Finishing products (show VOC content), photo of sample finished concrete, accessory materials.</li> <li>- Maintenance Requirements/Manual</li> <li>- Environmental Product Declarations (EPDs)</li> <li>- Health Product Declarations (HPDs)</li> </ul>
Product Samples		
Mock-ups	X	<ul style="list-style-type: none"> <li>- 18" x 18" min. mock-ups for stamped concrete paver treatment (In-situ mock-up is NOT acceptable.)</li> <li>- One sidewalk square (in-situ in a discrete location, approved by architect, is acceptable) for broom finish</li> </ul>
Closeout submittals	X	<ul style="list-style-type: none"> <li>- Warranty Information, O &amp; M Information</li> </ul>

3. PRODUCTS & PERFORMANCE

A. GENERAL REQUIREMENTS

- i. Supplemental Cementitious Materials: See structural specifications for requirements for minimum amounts of supplemental cementitious materials

B. NON-SLIP CONCRETE – AT EXTERIOR ENTRIES

- i. Product: Broom Finish Cast-in-place concrete
  - a. Compressive strength: per Structural for entry pads, and per Civil for all sidewalks and plazas
  - b. Slump: per Structural for entry pads, and per Civil for all sidewalks and plazas
  - c. Air Entrainment: per Structural for entry pads, and per Civil for all sidewalks and plazas
  - d. Admixtures: per Structural for entry pads, and per Civil for all sidewalks and plazas
  - e. SCM: See structural specifications for requirements for minimum amounts of supplemental cementitious materials (fly ash)

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- f. Curing: per Structural for entry pads, and per Civil for all sidewalks and plazas.
  - g. Broom Finish: Conform to ACI 301. Provide medium-coarse “broom finish” to match approved mock-up for exterior ramps, sidewalks, and stairs.
  - h. Joints: Construction Manager to suggest joint layouts at all work for architect and engineer review.
  - i. Steel Reinforcement: Comply with Division 03 “Cast-in-Place Concrete” for steel reinforcement and other reinforcement accessories.
- C. EXTERIOR CONCRETE FINISHING PRODUCTS
- i. Manufacturer: As recommended by contractor and approved by architect.
  - ii. Product: Penetrating Silicate sealers (one coat, 20 year life expectancy), or penetrating solvent-based Siloxane Sealer (3 coats, 5 year life expectancy).
- D. JOINT FILLER- EXTERIOR WORK
- i. Manufacturer: Tremco Sealants, WRMeadows, Pecora Corporation or approved equal.
  - ii. Product: Polyurea Joint Filler: Semi-rigid, Traffic grade, 2 component, self-leveling, 100% solids, rapid cure, Shore A 80 or higher hardness.
- E. SEALED CONCRETE
- i. Location: See finish plan for locations.
  - ii. Products: See floor sealer.
    - a. ANSI B101.1 Static Coefficient of Friction - Achieve a minimum of .42 for level floor surfaces.
    - b. ANSI B101.3 Dynamic Coefficient of Friction - Achieve a minimum of .35 for level floor surfaces.
- F. STAMPED CONCRETE AT PLAZA COMPASS ROSE – SEE CIVIL FOR SPECIFICATION
4. EXECUTION & QUALITY CONTROL
- A. TESTING:
- i. Coefficient of Friction: Achieve following coefficient of friction by field quality control testing in accordance to the following standards:
    - a. ANSI B101.1 Static Coefficient of Friction - Achieve a minimum of .42 for level floor surfaces.
    - b. ANSI B101.3 Dynamic Coefficient of Friction - Achieve a minimum of .35 for level floor surfaces.
- B. FIELD MOCK UPS: Before performing work of this Section, provide field mock-ups to verify selections made under submittals and to demonstrate aesthetic effects. Approval does not constitute approval of deviations from Contract Documents, unless Architect specifically approves deviations in writing.
- C. PRE-INSTALLATION CONCRETE CONFERENCE: Prior to placing of new or refinishing of existing concrete for areas scheduled for finish treatments and/or polishing, conduct conference at project site. Attendees to include: construction manager, architect, concrete producer (installer), concrete finisher, concrete polisher, technical product representative (sealer and color), person qualified to assess slip resistance. Agenda to include, but not be limited to the following:

- i. Demonstrate understanding of work required by reviewing and discussing proposed process and outcome.
  - ii. Tour field mock-up and representative areas of required work, discuss and evaluate for compliance with Contract Documents, including substrate conditions, surface preparations, sequence of procedures, and other preparatory work performed by other installers.
  - iii. Review approved submittals and field mock-up.
  - iv. Review the following:
    - a. Specific mix design.
    - b. Specified curing methods/procedures.
    - c. Projected 3, 10, and 28 day compression strength test related to specified aggregates exposure for finished floor and project phasing.
    - d. Protection of concrete substrate during construction and prior to polishing process
    - e. Project phasing and scheduling for each step of rubbing, sandblasting, grinding, honing and polishing operations.
    - f. Application of color, if applicable.
    - g. Application of liquid applied products, if applicable.
    - h. Protecting polished concrete floors after polishing work is complete, if applicable.
  - v. Reports: Record discussions, including decisions and agreements reached, and furnish copy of record to each party attending.
- D. FIELD CONDITIONS
- i. Damage and Stain Prevention: Take precautions to prevent damage and staining of concrete surfaces to be polished or to be exposed finished surfaces.
    - a. Prohibit use of markers, spray paint, and soapstone.
    - b. Prohibit improper application of liquid membrane film forming curing compounds.
    - c. Prohibit vehicle parking over concrete surfaces.
    - d. Prohibit pipe-cutting operations over concrete surfaces.
    - e. Prohibit storage of any items over concrete surfaces for not less than 28 days after concrete placement.
    - f. Prohibit ferrous metals storage over concrete surfaces.
    - g. Protect from petroleum, oil, hydraulic fluid, or other liquid dripping from equipment working over concrete surfaces.
    - h. Protect from acids and acidic detergents contacting concrete surfaces.
    - i. Protect from painting activities over concrete surfaces.
  - ii. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting liquid applied product application.

END SECTION 033300 KUA ARCHITECTURAL CAST-IN-PLACE CONCRETE

**055000 KUA METAL FABRICATIONS**

1. SUMMARY

This section identifies the metal fabrication of the exterior handrails, and interior handrail brackets, railing at upper-level balcony at the student lounge/common rooms, Knox Box, metal grating at elevator sump, standard countertop brackets, and other miscellaneous metal work. In addition, this section addresses the fabrication, fasteners, finishes and best practices for installation.

Related Sections:

081113 Hollow Metal Doors and Frames

099113 Exterior Painting

099123 Interior Painting and Staining

See Structural drawings for structural requirement of brackets.

See Structural Drawings for miscellaneous structural steel columns, baseplates, beams, elevator hoist beams, etc.

See Mechanical Drawings for galvanized steel equipment frames for exterior HVAC equipment.

See Civil drawings and specifications for steel bollards and bollard covers.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Shop drawing plans, sections, and details for fabrication of metalwork, metal brackets and railing. Installation details, metal grating details.
Product Cut Sheets	X	- For each listed product.
Product Samples	X	
Mock-ups	X	One panel of decorative guard at common room balconies.
Closeout submittals	X	Warranty Information, Maintenance information.

3. PRODUCTS

A. STAIR RAILING BRACKETS

- i. Manufacturer: Wagner Companies or approved equal.
- ii. Product: 1980ST Universal Weld steel handrail bracket or approved equal.
- iii. Location: At stud locations or on blocking as shown on the Drawings. Max spacing 4'-0".

B. EXTERIO STEEL HANDRAILS AT ENTRY STEPS

- i. Manufacturer: Custom – See Details on AK-9.1 / 5 and AW-9.1 / 5.
- ii. Product: Bar Steel
- iii. Finish: Grind all welds smooth to the hand touch. Galvanize, prime, and powdercoat in shop. Provide touch up in field as necessary.

C. Metal pipe handrails:

- i. Manufacturer: n/a



- ii. Product: 1 ¼" diameter steel piping, use pre-fabricated fitting for change of direction when possible.
  - iii. Finish: Grind all welds smooth to the hand touch. Provide with universal shop primer for field paint on steel.
- D. GUARD RAIL AT BALCONY/COMMON ROOMS
- i. Manufacturer: HOLAENDER <https://architecturalhandrail.hollaender.com/infill-panels/wire-mesh/> "SpeedRail" with WireMesh insert – note wood top rail - custom or equal.
  - ii. Product: Clear anodized finish railing with e-coated and powder coated 2x2" steel wire mesh infill.
  - iii. Dimensions: as shown on plans
  - iv. Finish: Grind all edges smooth. Provide with universal shop primer for field paint on steel.
  - v. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
    - a. Handrails:
      - 1. Uniform load of 50 lbf/ft. applied in any direction.
      - 2. Concentrated load of 200 lbf. applied in any direction.
      - 3. Uniform and concentrated loads need not be assumed to act concurrently.
      - 4. Top Rails of Guards:
        - 5. Uniform load of 50 lbf/ft. applied in any direction.
        - 6. Concentrated load of 200 lbf. applied in any direction.
        - 7. Uniform and concentrated loads need not be assumed to act concurrently.
      - 8. Infill Area of Guards:
        - 9. Horizontal concentrated load of 50 lbf. applied to 1 sq. ft. at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area. Load on infill area need not be assumed to act concurrently with loads on top rails.
  - vi. Mock-up Panel: one section of railing system for verification.
    - 1. Approximate Size: ¼ to ½ of full size, using full size components.
    - 2. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.
    - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents unless such deviations are specifically approved by Architect in writing.
- E. KNOX BOX
- i. Knox Company, Knox Box #3275 recessed mount with face flange, Dark Bronze.
  - ii. Location: Embedded in wall near main entrance at Kilton, Welch and each faculty residence.
- F. Metal grating at sump – if required.

- i. Product: Galvanized steel welded bar grating complying with NAAMM MBG 531 Metal Bar Grating Manual.
- ii. Size: 21" x 21" x 2" deep for 18"x 18" sump pit.
- iii. Fasteners: Use coated zinc-plated fasteners as required.
- iv. Fabrication: Shop fabricate to size indicated.

**G. COUNTER BRACKETS**

- i. Product: Powder-coated steel angle supports, for bathroom counters as shown on drawings – Details 4 and 6 on AK-6.5. Additional steel countertop brackets as shown on drawings and described in Interior Architectural Woodwork.
- ii. Spacing: Space as shown on drawings, or minimum 3'-0" apart. See Section for Interior Architectural Woodwork for countertop description.
- iii. For painted finish.

**H. PLAZA MEDALLION**

- i. Product: To be determined. Hold \$5000 allowance.

**4. EXECUTION & QUALITY CONTROL**

Install according to manufacturer's written instructions unless specifically noted otherwise.

END SECTION 055000 KUA METAL FABRICATIONS

**061000 KUA ROUGH CARPENTRY (ARCHITECTURAL)**

1. SUMMARY

This section includes all miscellaneous wood plates and bucks, non-bearing partitions, wood strapping at exterior walls, and wood blocking and nailers. This section also specifies the type of wood sheathing to be used as exterior wall sheathing. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

- 061000 Rough Carpentry (Structural)
- 062013 Exterior Finish Carpentry
- 062023 Interior Finish Carpentry
- 064023 Interior Architectural Woodwork
- 072500 Envelope Control Layers
- 079100 Movement Joints and Sealants
- 100000 All of Division 10- Specialties

See Structural Drawings and Specifications for structural rough carpentry.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Showing blocking location provided by each specialty.
Product Cut Sheets	X	- Wood-preservative treatment and fire-retardant treatment data from manufacturer. - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	NA	
Mock-ups	X	- Window bucks as part of window mock-up assembly. On-structure mock-up is acceptable.
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

A. PRESSURE TREATED LUMBER

- i. Product: Pressure Treated 2x lumber in sizes and locations as shown on the Drawings.
- ii. Type of Treatment: ACQ (alkaline copper quaternary)
- iii. Dimension: 1 1/2" x 3 1/2", 5 1/2", 7 1/4", 9 1/4" or 11 1/4" as required.
- iv. Locations: Window bucks, plates, any wood in damp locations or in direct contact with concrete or masonry, blocking at roof perimeter, miscellaneous locations.
- v. Protection: Flashing membrane installed between PT lumber and metal framing.
- vi. Fasteners: Stainless steel or proven compatible with pressure treated lumber.

B. EXTERIOR WALL SHEATHING

- i. Product: 1/2" CDX Plywood– See Structural. (see 072100 Thermal Insulation for additional information)

- ii. Locations: All exterior walls (see details for location of sheathing in wall sections)
  - iii. Installation: Per Structural and manufacturer's instructions
- C. ROOF SHEATHING- (See Structural)
- i. Product: 5/8" Advantech, OAE, sheathing (see 072100 Thermal Insulation for additional information)
  - ii. Locations: As indicated on drawings. All roof decks, to provide weather protection prior to roofing.
- D. EXTERIOR STRAPPING
- i. Product: 1x3 and 2x3, 1x8 at corners, wood strapping as shown on drawings (may be 1" rough-sawn local wood if avail.)
  - ii. Locations: Provide strapping as shown on the drawings and at the following:
    - a. At stud locations over rigid insulation at siding, 16" oc typical unless otherwise noted.
- E. EXTERIOR BLOCKING FOR METAL FLASHINGS
- i. Product: 2x4, 2x6 and ripped 2x SPF #2 wood as shown on drawings
  - ii. Locations: Provide solid blocking under custom-bent metal trim and or gutter profiles, as shown on the drawings and details.
- F. NON-BEARING WALL PARTITIONS
- i. Product: 2x4 and 2x6 SPF #2 wood studs and plates.
  - ii. Bottom plates in contact with concrete to be pressure-treated.
  - iii. Locations: at locations shown on plans and denoted by wall section types.
- G. PLYWOOD AND DIMENSIONAL LUMBER BLOCKING AND WINDOW BUCKS
- i. Product: 3/4" exterior grade CDX plywood or 2x #2 lumber as indicated.
  - ii. Locations: Provide blocking as shown on the drawings and at the following:
    - a. Miscellaneous trim backer at roof and cornices.
    - b. Plumbing Fixtures including wall hung toilets and sinks, drinking fountains, grab bars, and all other toilet accessories: Plywood to extend 8" beyond fixture dimensions in all directions.
    - c. Base, Wall Cabinet, and shelving attachment points: Centered at 35 inches for base cabinets, at top and bottom of wall cabinets as shown on the Drawings.
    - d. Shelving and worksurface attachment as shown on the Drawings.
    - e. Handrail wall bracket locations: Plywood extending 8" beyond fixture dimensions in all directions.
    - f. Door stops: Plywood extending 8" beyond fixture dimensions in all directions.
    - g. Fire extinguisher hangers and cabinets: Plywood extending 8" beyond fixture dimensions in all directions.
- H. INTERIOR WOOD FURRING
- i. Product: wood strapping or resilient channel as shown on drawings
  - ii. Locations: see wall types and details.
- I. PLYWOOD BACKING PANELS

- i. Product: Exterior grade AC plywood, fire-retardant treated, 3/4" thickness and where indicated on the drawings.
  - ii. Locations:
    - a. Elevator Machine Room
    - b. Electrical and Mechanical rooms
    - c. At Water Entrance
- J. FASTENERS
- i. All Fasteners in rough carpentry to be galvanized or coated steel.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. EXTERIOR SHEATHING AND ROOF DECK:

- i. Exterior Sheathing and decking serves as the primary air barrier.
- ii. See Section 073500 Envelope Control Layers for tapes and air-sealing details.

B. BLOCKING:

- i. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- ii. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- iii. Attach items to substrates to support applied loading. Recess fasteners flush with surfaces unless otherwise indicated.
- iv. Where wood-preserved-treated lumber is installed adjacent to metal framing or decking, install continuous flexible flashing separator between wood and metal.

C. FRAMING REPAIR:

- i. Examine structure of roof and opened up existing areas of work for rot.
- ii. Remove and/or repair rotted material with P.T. framing/sheathing after consultation with architect and structural engineer.

END SECTION 061000 KUA ROUGH CARPENTRY (ARCHITECTURAL)

**062013 KUA EXTERIOR FINISH CARPENTRY**

1. SUMMARY

This Section includes exterior wood trim at the exterior of the building:

- Exterior standing and running trim, including- drip edges, fascias, frieze boards, and trim at porches and canopies.
- Exterior trim blocks for lights, and other wall mounted services and penetrations in siding.
- Miscellaneous exterior wood trim.

Related Sections:

- 061000 Rough Carpentry
- 072100 Thermal Insulation
- 072500 Envelope Control Layers
- 074500 Mineral-Fiber-Reinforced Cementitious Panels
- 099113 Exterior Painting

See also Structural drawings, specifications, and relevant architectural drawings for Exterior Wood and Steel columns.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- For any custom parts fabricated off-site prior to installation.
Product Cut Sheets	X	- All listed products - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	- Each type of wood with exposed surface finished
Mock-ups	X	- On-structure mock-up is acceptable
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

- A. EXTERIOR SOFFIT MATERIALS- PAINTED
  - i. Material: 1x6 V-groove (clr. Pine)
  - ii. Fastening: concealed, stainless steel nails.
  - iii. Finish: Primed for painted finish, See Exterior Paints and Finishes 099113.
  - iv. Location: Underside of roof eave and rake soffits, and where shown on the drawings.
  
- B. EXTERIOR SOFFIT MATERIALS- NATURAL @ PORCHES
  - i. Material: 1 x 6 Tongue and Groove (T&G) select vertical grain douglas fir boards, face fastened with stainless steel finish screws, 16" OC minimum.
  - ii. Fastening: concealed, stainless steel nails.
  - iii. Finish: Clear, See Exterior Paints and Finishes 099113.

- iv. Location: Underside of entry canopies, and where shown on the drawings.
- C. LUMBER- TRIM FOR PAINTED FINISH- NEW OR REPLACEMENT
- i. Species and Grade: Pressure-treated radiata pine
  - ii. Maximum Moisture Content: 15%
  - iii. Finger Jointing: Not Allowed
  - iv. Face Surface: Smooth
  - v. Any Knots to be BIN primed before painting.
  - vi. Primed stock is acceptable.
  - vii. Will consider pre-manufactured, composite products at recommendation of contractor – per submittal process.
  - viii. Dimensions and locations: as noted on drawings.
- D. MISCELLANEOUS MATERIALS
- i. Fasteners: Provide galvanized (or stainless where indicated) steel nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.
  - ii. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry. (Green Source or other – low-VOC).
  - iii. Sealants: Latex or silicone as appropriate for finish and water resistance.
  - iv. Drip edges and Z-flashing. Provide painted drip edge and/or Z-flashing at top surface of all horizontal trim with water shedding elements above (i.e. siding).
4. EXECUTION & QUALITY CONTROL
- A. PREPARATION
- i. Store and install all lumber, sheet goods, and other material so it is flat and protected from weather and other sources of moisture.
  - ii. Stack lumber, sheet goods, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
  - iii. Do not install materials that are wet, moisture damaged or mold damaged.
  - iv. Clean and examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance.
  - v. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
  - vi. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. INSTALLATION, GENERAL
- i. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
  - ii. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
  - iii. Scribe and cut exterior finish carpentry to fit adjoining work. Seal cuts and ends with same finish as material.
  - iv. Install to tolerance of 1/8 inch in 96 inches for level and plumb.
  - v. Use scarf joints for end-to-end trim joints.
  - vi. Stagger end joints in adjacent and related members.

- vii. Install trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long except where necessary.
  - viii. Coordinate exterior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.
  - ix. Fit exterior joints to exclude water. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.
  - x. Unless otherwise indicated, countersink fasteners, fill surface flush, and sand where face fastening is unavoidable.
  - xi. Backprime all trim lumber and add primer & paint at all cuts made during installation.
  - xii. Sealant Use: Caulk all butt joints.
  - xiii. For clear finish sheet goods, provide galvanized fasteners. Fastening pattern to be confirmed with Architect prior to installation.
- C. REPAIRS AND PROTECTIONS
- i. Replace exterior finish carpentry that is damaged or does not comply with requirements. Repair if work complies with requirements and shows no evidence of repair or refinishing.
  - ii. Protect installed products from damage from weather and other causes during construction.

END SECTION 062013 KUA EXTERIOR FINISH CARPENTRY



**066400 KUA PLASTIC PANELING**

1. SUMMARY

This section identifies the Fiberglass Reinforced Wall Panels (FRP) adhered to gypsum wallboard at the janitorial closets and laundry rooms in the dormitory and faculty residences (new construction). In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

- 061001 Miscellaneous Rough Carpentry
- 064023 Interior Architectural Woodwork
- 092900 Gypsum Board
- 096513 Resilient Base and Accessories
- 099123 Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	-
Product Cut Sheets	X X	- Each listed product.
Product Samples	X	FRP color and finish sample, connector pieces, hardware, etc. samples
Mock-ups	NA	
Closeout submittals	X X	Warranty Information Maintenance Information

3. PRODUCTS

A. FIBERGLASS REINFORCED WALL PANELS

- i. Manufacturer: Marlite, Crane Composites or approved equal
- ii. Product: Marlite Standard or Artizan FRP, Glasbord, Prefinished polyester glass reinforced plastic sheets and adhered to unfinished gypsum wallboard.
- iii. Dimension: 5’ height, 0.090" minimum thickness, 4’ width.
- iv. Color: As selected by Architect from the full range of industry colors.
- v. Surface: Pebbled

B. INSTALLATION MATERIALS AND ACCESSORIES

- i. Aluminum or PVC Trim:
- ii. Outside Corner Guard: Stainless Steel.
- iii. Fasteners: Non-staining nylon drive rivets to match panel colors.
- iv. Adhesives: Water-resistant, VOC content of 60 g/L or less.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. PREPARATION

- i. Prepare substrates to be free of coatings, sealers or hardeners. Fill cracks, holes flush with adjoining surface.

B. INSTALLATION

- i. Cut sheets to meet supports allowing 1/8" (3 mm) clearance for every 8 foot (2.4m) of panel. Install after painting and ceiling operations have been completed.
- ii. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.
- iii. Apply panel moldings to all panel edges using silicone sealant providing for required clearances.

C. CLEANING AND PROTECTION

- i. Comply with manufacturer's written instructions for cleaning and protection after installation.
- ii. Cover until Substantial Completion.

END SECTION 066400 KUA PLASTIC PANELING

**071113 KUA FOUNDATION MOISTURE PROTECTION & DAMP PROOFING**

1. SUMMARY

This section identifies foundation damp proofing and/or waterproofing required at the exterior surfaces of the concrete foundation walls, as well as protection board and capillary break material between footings and foundation walls.

Related Sections:

033000 Cast-in-Place Concrete, and see Structural Drawings

072100 Thermal Insulation

072500 Envelope Control Layers

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	-
Product Cut Sheets	X	- All listed products - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Compatibility	X	- Provide confirmation of control layer and adhesive product compatibility with adjacent products.
Product Samples	X	All listed products
Mock-ups		
Closeout submittals	X	Warranty Information

3. PRODUCTS

A. FOUNDATION CAPILARY BREAK MATERIAL

- i. Manufacturer: Grace or approved equal
- ii. Product: Grace peel and stick waterproofing membrane
- iii. Properties: 40 mil thickness, 10 year warranty,
- iv. Location: On top of footing at foundation wall locations

B. FOUNDATION WALL DAMP-PROOFING

- i. Manufacturer: Tremco or approved equal
- ii. Product: Tremco Watchdog H3, spray-applied polymer-enhanced asphalt liquid applied membrane.
- iii. Properties: 40 mil cured thickness, 10 year warranty, 3' hydrostatic head resistance.
- iv. Location: At elevator pit walls and walls below garden level slab.

C. FOUNDATION WALL WATER-PROOFING

- i. Manufacturer: Tremco or approved equal

- ii. Product: Tremco Watchdog H3, spray-applied polymer-enhanced asphalt liquid applied membrane.
- iii. Properties: 40 mil cured thickness, 10 year warranty, 3' hydrostatic head resistance.
- iv. Location: At all foundation walls that enclose conditioned space.

**D. FOUNDATION WALL WATER- PROOFING PROTECTION BOARD**

- i. Manufacturer: Tremco or approved equal
- ii. Product: Tremco EnForce Protection Board or approved equal.
- iii. Properties: Non-woven thermoplastic protection Board
  - a. Drainage: 44 gallons/hr/lin. Ft
  - b. Thermal Resistance: R-3
  - c. Recycled content: greater than 70%
  - d. Board Dimension: 3'x4'
- iv. Location: At all foundation walls that enclose conditioned space.

**4. EXECUTION & QUALITY CONTROL**

**A. PREPARATION**

- i. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  - a. Verify that substrates are free of oil, grease, dirt and other contaminants.
  - b. Verify that concrete is visibly dry and free of moisture as recommended by damproofing manufacturer, and has cured for minimum time period recommended by manufacturer.

**B. FOUNDATION DAMP-PROOFING**

- i. Apply from sub-grade portion of the walls down to the top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.
- ii. Architect shall inspect and approve damp-proofing before backfill.

**C. PROTECTION**

- i. Keep all materials dry, clean, and protected from the weather prior to installation.
- ii. Clean construction spills and remove masking materials after installation.
- iii. Water proofing shall not be visible on the foundation wall above grade. Any splashes or spills that are visible will need to be removed by the contractor.

END SECTION 071113 KUA FOUNDATION MOISTURE PROTECTION & DAMPROOFING

**072100 KUA THERMAL INSULATION**

1. SUMMARY

This section identifies the exterior insulation to be used at the foundation, slab and walls, and roof, as well as interior sound insulation. ***In general, any rigid insulation having ground contact will be EPS (i.e. the under-slab insulation and foundation perimeter insulation). The rigid insulation shown in interior applications and/or above grade non-ground contact installations will be rigid polyisocyanurate board. Exterior framed wall cavities will use dense-pack cellulose unless otherwise noted.*** Some difficult to insulate locations in the existing buildings will require closed-cell spray foam. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Target insulation values for this project are:

Sub-slab	R-20
Foundation walls	<b>R-20</b>
Above-Grade Walls	<b>R-40</b>
Roof Insulation	<b>R-60</b>

Note that this project will be subject to the INTERNATIONAL ENERGY CONSERVATION CODE (IECC) 2018. These regulations stipulate standards for thermal energy performance, as well as air tightness, including the requirement to test the building envelope. The Thermal Insulation, Envelope Control Layers, Joint Sealant, Door and Window specifications, in concert with the architectural drawings, provide additional information and detailing for satisfying these requirements. While the Air Tightness Compliance Testing as noted in the Envelope Control Layer specification provides guidance for the testing process.

Related Sections:

- 033000 Cast-in-Place Concrete (see structural specs)
- 061000 Rough Carpentry (architectural)
- 061010 Rough Carpentry (structural)
- 062023 Interior Finish Carpentry
- 071113 Foundation Moisture Protection & Damproofing
- 072500 Envelope Control Layers
- 073113 Asphalt Roofing
- 079100 Movement Joints and Sealants
- 079200 Joint Sealants

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Details for board insulation attachment
Product Cut Sheets	X	- For each listed product - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs) - <b><i>Proof of packaging and labeling requirements for foam plastic insulation per IBC 2603.2</i></b>

**KUA Kilton/Welch Dormitories & Faculty Residences**

Vermont Integrated Architecture, P.C.

March 27, 2023 – Bid Package 1

Revised - May 15, 2023 – Bid Package 2

Compatibility	X	<ul style="list-style-type: none"> <li>- Provide confirmation of control layer and adhesive product compatibility with adjacent products, see Section 072500 Envelope Control Layers.</li> <li>- No enclosure submittals will be approved until this matrix is submitted. (An example for a previous project may be requested from the Architect if the contractor and subcontractors are unfamiliar with this practice.)</li> </ul>
Product Samples	NA	
Mock-ups	X	<ul style="list-style-type: none"> <li>- Exterior wall mock-up with window opening, with all envelope control layers and sealants and demonstrating connections, terminations, and flashings.</li> <li>- On-structure mock-up is acceptable. Testing of this mock-ups per Sections 019119 Exterior Envelope Commissioning and 014517 Field Testing of Exterior Assemblies to be coordinated with Envl. Cx. agent and Architect.</li> </ul>
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

**EXTRUDED POLYSTYRENE BOARD (XPS) IS NOT ACCEPTABLE FOR USE ON THIS PROJECT WITHOUT EXPRESS PERMISSION FROM THE ARCHITECT.**

**A. GENERAL REQUIREMENTS FOR THE USE OF FOAM PLASTIC INSULATION (per IBC)**

**i. SECTION 2603.2 –Foam Plastic Insulation Labeling and Identification**

**a. Packaging and labeling requirements for foam plastic insulation shall bear the label of an approved agency showing manufacturer’s name, product listing, product identification, and information sufficient to determine that the end use will comply with the code requirements.**

**ii. SECTION 2603.3 –Surface burning characteristics**

- a. Flame spread Index: not more than 75**
- b. Smoke-Developed Index: not more than 450 (ASTM E84 or UL 723)**
- c. See also Loose-fill testing requirements and code listed exceptions.**

**B. EXPANDED POLYSTYRENE BOARD (EPS) INSULATION *RECYCLED/SALVAGED FOR REUSE (GROUND CONTACT RIGID INSULATION)***

**i. Manufacturer:** Dow Chemical Company, Branch River, Atlas, Shelter Foam, or approved equal.

**ii. Product:** Expanded Polystyrene Board (EPS) Insulation, Type II, 15 psi., with insect preventative

**a. Documentation of a price premium and/or proof of unavailable quantities of the specific material type are required as a part of the submittal if new/virgin material is intended for use instead.**

**iii. Sourcing: <https://www.greeninsulationgroup.com/>, (Serving New England and based in Worcester, MA)**

**iv. Locations: as noted on drawings**

**a. Continuous. Maximum gap between panels of one-quarter inch - fill all gaps.**

- 
- v. Thickness:
    - a. ***As noted in drawings to meet required R values.***
  - vi. Gaps: 1/8" gaps or less to be filled with sealant, gaps larger than 1/8" to be filled with one-part high expansion spray foam.
  - vii. ***Covering: In locations with exposed interior foam, protection may be required, see above.***
- C. POLYISOCYANURATE BOARD INSULATION ***RECYCLED/SALVAGED FOR REUSE (NON-GROUND CONTACT RIGID INSULATION)***
- i. Manufacturer: Dow Chemical Company, ACH, Atlas, or approved equal.
  - ii. Product: Polyisocyanurate board Insulation, fiberglass, or foil faced.
  - iii. Thermal Performance: min R-5.6/inch (aged, measured at 75°F, ASTM C518)
    - a. ***Documentation of a price premium and/or proof of unavailable quantities of the specific material type are required as a part of the submittal if new/virgin material is intended for use instead.***
  - iv. ***Sourcing: <https://www.greeninsulationgroup.com/>, (Serving New England and based in Worcester, MA)***
  - v. ***Locations: as noted on drawings***
    - a. ***Continuous. Maximum gap between panels of one-quarter inch - fill all gaps.***
  - vi. ***Thickness:***
    - a. ***As noted in drawings to meet required R values.***
  - vii. Gaps: 1/8" gaps or less to be filled with sealant, gaps larger than 1/8" to be filled with one-part high expansion foam.
  - viii. ***Covering: In locations with exposed interior foam, protection may be required, see above.***
- D. CELLULOSE INSULATION – Loose-Fill for Attics and Dense Pack for Walls
- i. Manufacturer: Nu-wool, Greenfiber, Igloo, or approved equal
  - ii. Product: Cellulosic-Fiber Insulation: Formaldehyde and ammonium sulfate free formula, with borate treatment and min. 80% post-consumer recycled content.
  - iii. Moisture Content per manufacturer's installation requirements.
  - iv. Fill and Density per manufacturer's installation requirements.
  - v. Formaldehyde free formula with borate flame and insect resistance treatment.
  - vi. Thermal Performance: min as noted below for wood frame construction (aged, measured at 75°F, ASTM C518)
    - a. Exterior Walls:
      - 1. 2x6 = R-20 (3.4 pcf installed density)
    - b. Attic: See drawings for dimensioned depths of loose fill.

Loose Fill Cellulose  
(Attic Floors or Open Cavities)  
(Coverage per 25 lb. Bag)

R-Value	Installed Depth (Inches)	Settled Depth (Inches)	*Coverage per Bag (Net SqFt)
13	4.3	3.8	85.8
15	4.8	4.3	72.0
19	5.9	5.3	50.5
22	6.8	6.1	41.6
26	7.9	7.1	33.9
30	9.1	8.1	28.3
34	10.1	9.1	24.5
38	11.4	10.2	21.4
40	11.8	10.7	20.1
45	13.2	12.0	17.7
49	14.5	13.1	16.0
53	15.5	14.2	14.7
56	16.4	14.9	13.9
60	17.7	16.0	12.8
64	18.7	17.1	12.0
68	19.8	18.1	11.3
72	21.0	19.1	10.6
76	22.1	20.2	10.0
80	23.3	21.3	9.5
84	24.5	22.3	9.0
88	25.6	23.4	8.6
92	26.8	24.4	8.2
96	27.9	25.5	7.8
100	29.1	26.5	7.5

c.

E. EXTERIOR WALL BATT INSULATION – MINERAL WOOL

- i. Manufacturer: Rockwool, Owens Corning, Certainteed, or approved equal.
- ii. Product: High-density, formaldehyde-free unfaced batt insulation
- iii. Exterior Walls at basement concrete foundation walls only: 5.5" cavity insulation (min R-4/inch = R-21 nominal, w/ 20% framing discount for 16" o.c. framing actual R= 17.6)
- iv. As shown on the Drawings.
- v. **Installation: Maximum gap between panels of one-quarter inch - fill all gaps.**

F. ACOUSTIC INSULATION- BATT

- i. Manufacturer: Rockwool, Thermafiber, DOW, Owens Corning, Certainteed or approved equal.
- ii. BOD Product: Formaldehyde-free Fiberglass or mineral wool "SafenSound" or SAFB acoustical batt insulation or approved equal.
  - a. Note: Mineral wool may be required per life safety code at areas requiring non-combustible insulation. See drawings.
- iii. Dimension: 3.5" or 6" x 16.25" or 24.25" x 96" batts where indicated at wall or ceiling.

G. MINERAL-WOOL BATT- FIRE INSULATION

- i. Manufacturer: Rockwool, Thermafiber or approved equal.
- ii. Product: "SafenSound" or SAFB acoustical insulation or approved equal.
- iii. Dimension: Strips as specified by UL Label fire closure system.
- iv. Locations: Where indicated and at all door frames.

H. CLOSED-CELL SPRAY POLYURETHANE FOAM (LOW-GWP)



- i. Manufacturer: Lapolla Industries or Demilec Heatlok HFO, with Solstice-LBA blowing agent by Honeywell, or approved equal.
  - ii. BOD Product: Low-GWP-blown closed-cell spray foam. Foam-Lok 2000-4G, or approved equal.
  - iii. maximum flame-spread = 25
  - iv. smoke-developed indexes = 450
  - v. minimum density of 2.0 lb/cu. ft.,
  - vi. Zero ozone depletion: 0
  - vii. Blowing agent Global Warming Potential:  $GWP_{100} < 25$ , which can be met with either of the following:
    - a. Use of a natural refrigerant (i.e. pentane and cyclopentane), or
    - b. a synthetic refrigerant with a  $GWP_{100} < 5$
  - viii. Thermal Performance: min R-6.6/inch (aged, measured at 75°F, ASTM C518)
  - ix. Covering: In locations with exposed foam, provide 15 minute rated intumescent coating per life safety code.
  - x. Installer: Certified installer with minimum 6 months experience.
  - xi. Thickness: As indicated on drawings
    - a. In lifts as recommended by manufacturer's instructions.
    - b. As shown on details for air sealing or where main insulation thickness is compromised.
  - xii. Locations/Installation:
    - a. As shown on the Drawings. (Existing Kilton Dorm Roof upgrades and Welch Faculty Residence upgrades to walls and roof, specifically.)
- I. JOINT-AND-PENETRATION TREATMENT MATERIALS
- i. Manufacturer: Todol Products or approved equal.
  - ii. Product: Pur-Fill 1G, non-CFC, Spray foam- low and high expanding as appropriate or approved equal. Low-expanding for use at window and doors where specified and high expansion in all other locations.
  - iii. At window rough openings: Use low expanding spray foam to fill cavity if allowed/recommended by window manufacturer.
  - iv. At other penetrations through envelope and gaps in rigid insulation: Use Pur-Fill as necessary to supplement Spray Polyurethane Foam, but do not depend on Pur-Fill as air/weather barrier.
- J. MISCELLANEOUS MATERIALS
- i. Product: Use insulation manufacturer's recommended adhesive, tapes, and fastener attachment spacing for each type of insulation and/or listed product.
  - ii. Product: Acoustical Sealant- joint sealant for interior gaps under ¼". Low-VOC products for any/all interior applications is preferred.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. GENERAL

- i. Install only insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
  - ii. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
  - iii. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise indicated. Stagger insulation joints if multiple layers.
- B. INSTALLATION OF SUB-SLAB INSULATION**
- i. Vertical surfaces: Extend to top of footing unless otherwise indicated.
  - ii. Horizontal surfaces: Loose lay and tightly abut horizontal insulation units to minimize gaps. Seal gaps as noted. Extend insulation over the entire horizontal sub-slab surface unless otherwise indicated.
- C. INSTALLATION OF EXTERIOR WALL RIGID INSULATION**
- i. Install per manufacturer's specifications. Attach with strapping or attach to allow for later installation of strapping.
- D. INSTALLATION OF LOOSE FILL/DENSE PACKED CELLULOSE**
- i. Install per manufacturer's recommendations.
  - ii. Air seal all penetrations, base and top plates prior to installation of cellulose.
  - iii. Install dense packed cellulose to minimum density of 3.5 PCF.
- E. INSTALLATION OF EXTERIOR WALL INSULATION BATTS**
- i. For framed wall cavities where cavity insulation heights exceed 96 inches, support un-faced blankets mechanically.
  - ii. Provide class 1 installation with no gaps or compression.
- F. INSTALLATION OF INTERIOR SOUND INSULATION BATTS**
- i. For framed wall cavities where cavity insulation heights exceed 96 inches, support un-faced blankets mechanically.
  - ii. Where batts are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated, with mechanical support. Extend wall insulation to deck (or plate) with acoustical sealant as shown on partition schedule.
- G. INSTALLATION OF SPRAY FOAM INSULATION**
- i. Apply as specified by manufacturer for weather conditions.
  - ii. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets penetrating walls is completed, and windows, electrical boxes, and other items not indicated to receive insulation are masked.

END SECTION 072100 KUA THERMAL INSULATION

**072500 KUA ENVELOPE CONTROL LAYERS**

1. SUMMARY

This section identifies the vapor, air and weather control layers at the exterior walls; and associated tapes, fasteners, sealants, and best practices for installation.

Related Sections:

- 033000 Cast-in-Place Concrete (see structural specs)
- 061000 Rough Carpentry
- 062013 Exterior Finish Carpentry
- 062023 Interior Finish Carpentry
- 071113 Foundation Moisture Protection & Damproofing
- 072500 Envelope Control Layers
- 073100 Slate Roof Repair and Cladding
- 073113 Asphalt Roofing
- 079100 Movement Joints and Sealants
- 079200 Joint Sealants
- 099113 Exterior Painting and Staining

Note that this project will be subject to the INTERNATIONAL ENERGY CONSERVATION CODE (IECC) 2018. These regulations mandate thermal energy performance, as well as air tightness, including the requirement to test the building envelope. The Thermal Insulation, Envelope Control Layers, Joint Sealant, Door, and Window specifications, in concert with the architectural drawings, provide the structure for satisfying the air sealing requirements for the building. While the Air Tightness Compliance Testing as noted in section E.ii. of the Envelope Control Layer specification provides guidance for the testing process, the OPR specifies goals and requirements for meeting our Net Zero Energy Ready target.

Minimum air tightness performance metrics:

Dorms and faculty residences/New Construction:

**Air/Vapor-Barrier Assembly Air Leakage Requirement: Maximum 0.1 cfm per sq. ft. of six-sided exterior shell at 50 Pa pressure.**

***Printing Note: Detail sheets depicting envelope control layers are to be printed in full color. Incorrect control layer installation due to black & white prints shall be the responsibility of the Construction Manager.***

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	-
Product Cut Sheets	X	- All listed products - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)

**KUA Kilton/Welch Dormitories & Faculty Residences**

Vermont Integrated Architecture, P.C.

March 27, 2023 – Bid Package 1

Revised - May 15, 2023 – Bid Package 2

Compatibility Matrix	X	- Provide confirmation of control layer and adhesive product compatibility with adjacent products. - No enclosure submittals will be approved until this matrix is submitted.
Product Samples	X	- All listed products
Mock-ups	X	- Exterior wall mock-up with window opening, with all envelope control layers and sealants. - On-structure mock-up is acceptable. Testing of this mock-ups per Sections 019119 Exterior Envelope Commissioning and 014517 Field Testing of Exterior Assemblies to be coordinated with Envl. Cx. agent and Architect.
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

- A. UNDERSLAB VAPOR CONTROL LAYER - SHEET MEMBRANE: SUB-SLAB
  - i. Manufacturer: Stego Industries, LLC, Husky, OAE
  - ii. BOD Product: Stego Wrap Vapor Barrier, Husky Yellow Guard, OAE
  - iii. Thickness: 15 mil.
  - iv. Permeance Rating: maximum permeance rating of 0.0086 perms.
  - v. Dimension: 14 ft x 140 ft roll.
  - vi. Installation: Provide under all new slabs, extending out and taped to wall vapor control layers. See details.
  
- B. UNDERSLAB VAPOR CONTROL LAYER JOINT-AND-PENETRATION TREATMENT MATERIALS
  - i. Manufacturer: Stego Industries, LLC, Husky, OAE
  - ii. BOD Products:
    - a. Stego Tape- 3.75" x 180' roll polyethylene tape w/ acrylic adhesive. 6mil, 0.03perms, OAE
    - b. Stego Mastic- 2 gallon and 5 gallon buckets. 0.17 perms, OAE
    - c. Stego Crete Claw, 6". 26mil, 0.03 perms, OAE
    - d. Stego Tack Tape, 2". 30mil, 0.03 perms, OAE
  
- C. SILL SEAL
  - i. Manufacturer: Conservation Technology,  
**a. [http://conservationtechnology.com/building\\_gaskets.html](http://conservationtechnology.com/building_gaskets.html)**
  - ii. BOD Product: EPDM sill gasket
  - iii. **Size/Type: as appropriate for wall sill plate sizes (wood or metal) as noted on drawings.**
    - a. BG-72, BG-73, BG75, BG77**
  
- D. INTERIOR VAPOR VARIABLE MEMBRANE
  - i. Manufacturer: Pro Clima/ Moll bauökologische Produkte, Imported by 475 High Performance Building Supply, 131 Union Street, Brooklyn NY, 11231 Tel: 718-622-1600; Email: info@foursevenfive.com; Web: www.foursevenfive.com

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- ii. BOD Product: 'Intello +' Class Reinforced Polyethylene Copolymer Vapor Retarder membrane A, B & C, 15 mils thick, OAE
  - iii. Permeance Rating: Variable permeance rating of 0.13- 13.2 perms.
  - iv. Vapor-Retarder Tape and Fasteners: Pressure-sensitive tape and fasteners of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder. Pro Clima Vana
  - v. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and with demonstrated capability to bond vapor retarders securely to substrates indicated.
  - vi. Pipe, duct and cable sealing in Reinforced Polyethylene Copolymer Vapor Retarder: ROFLEX and KAFLEX gaskets.
  - vii. Alternate: Certainteed "Membrain" vapor variable membrane with Insulweb netting behind.
- E. SPRAY / LIQUID APPLIED VAPOR-OPEN AIR CONTROL LAYER - FOR RENOVATED MASONRY WALL LOCATIONS**
- i. **BOD Product: "Visconn" or approved equal: Liquid-applied air barrier for robust connections. For use as ACL, flashing for pitched windows sills, and other detailing. VISCONN® can be brushed, rolled, or sprayed as a liquid film and dries to form a seamless, elastic, airtight and vapor-variable membrane.**
  - ii. **Manufacturer: Pro Clima/Moll.**
  - iii. **Substrate: Existing Masonry**
  - iv. **Perm Rating: 0.5 perms (6.11m ±0.6 m) at 11 mils (0.3 mm) thickness EN 1931.**
  - v. **Vapor Variability: ISO 12572: 0.33 to 25 perms (Sd: 0.13 – 10.00 m)**
  - vi. **Installation: Install per manufacturer's instructions and requirements with all required surface cleaning/preparation, pre-treatments, fasteners, seals, terminations, and treatment of penetrations.**
  - vii. **Locations: Applied to the interior of Masonry brick and CMU walls at envelope upgrade areas, and as indicated on drawings.**
- F. EXTERIOR WALL AIR-CONTROL LAYER AND WEATHER RESISTIVE BARRIER - FOR NEW CONSTRUCTION**
- (OPTIONS ARE PROVIDED AS NOTED BLEOW AND WILL BE CONSIDERED EQUALS TO ALLOW INSTALLER FLEXIBILITY TO BRING THE OWNER GREATEST VALUE WHILE MEETING ALL NECESSARY PERFORMANCE TARGETS.)**
- i. **OPTION A:**
    - a. **Air-Control layer: Taped plywood sheathing.**
      - 1. **All seams and penetrations fully sealed. (See below for acceptable tapes.)**
      - 2. **Locations: as shown on drawings at NEW exterior walls and indicated by GREEN dashed line.**
    - b. **Weather Resistive Barrier:**
      - 1. **BOD Product: Tyvek (or approved equal) WRB**
      - 2. **Manufacturer: Dupont Commercial Tyvek or approved equal**
      - 3. **Substrate: Plywood sheathing**

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4. **Installation: Installed “weather board” fashioning beginning at the bottom and lapping each course. Install per manufacturer’s instructions and requirements with all required fasteners, seals, terminations, and treatment of penetrations.**
  5. **Locations: as shown on drawings at NEW exterior walls and indicated by PURPLE dashed line.**
- ii. **OPTION B:**
- a. **Combination Air-Control layer and Weather Resistive Barrier:**
    1. **Manufacturer: Pro Clima, Siga, Henry, or approved equal.**
    2. **BOD Product: Proclima Mento 1000, Henry Blueskin, Siga Majvest, or approved equal.**
    3. **Substrate: Plywood sheathing**
    4. **Installation: Installed “weather board” fashioning beginning at the bottom and lapping each course. Install per manufacturer’s instructions and requirements with all required fasteners, seals, terminations, and treatment of penetrations.**
    5. **All seams and penetrations fully sealed. (See below for acceptable tapes, gaskets, boots, and associated materials.)**
    6. **Locations: Covering all plywood sheathing, as air and weather barrier and as shown on drawings at NEW exterior walls and indicated by adjacent GREEN dashed line and PURPLE dashed line.**
- G. AIR CONTROL LAYER **TAPE** / WEATHER BARRIER TAPE
- i. Manufacturer: 3M, Siga, Pro Clima, Henry, Huber, Venture, OAE.
  - ii. BOD Products: Siga Wigluv, Pro Clima Tescon Vana, 3M All weather flashing tape 8067, or approved equal that is compatible with exterior air/weather **control layers** to provide **continuity**.
  - iii. **Gaps: Tape is not capable of spanning large gaps and maintaining integrity. Gaps over ¼” must be repaired, filled, and then sealed.**
  - iv. Location: At all joints in membrane, between membrane and plywood sheathing and connecting materials, and over fasteners **to provide continuous air/weather control. Note, different materials may be required at different locations to accommodate 3-d geometries, ensure material compatibility, and to address various field conditions.**
- H. FOUNDATION TO WALL TAPE
- i. Manufacturer: 3M, Siga or approved equal.
  - ii. Product: 3M All weather flashing tape 8067, Siga Fentrim, with split backing, or similar flexible waterproof tape intended for fastening to concrete.
  - iii. Location: Foundation wall to sheathing connection.
- I. WINDOW SILL FLASHING TAPE
- i. Manufacturer: Proclima, Siga, Huber, or approved equal.
  - ii. Product: ProClima Extoseal Encors, Siga Majvest, ZIP flex tape, or similar flexible waterproof tape intended for sill use. Confirm suitability w/ window material and weather barrier. (Rubberized Asphalt tapes are not acceptable)
  - iii. Location: Window sill pans, door sills without manufacturer’s pans.

J. WINDOW HEAD AND JAMB FLASHING TAPE

- i. Manufacturer: Proclima, SIGA, Huber, or approved equal.
- ii. Product: ProClima Vana, SIGA Wigluv, ZIP tape, or similar flexible tape for exterior applications. Confirm suitability w/ window material and weather barrier.
- iii. Location: Window and door rough openings

K. AIR SEALING SYSTEMS/CONNECTIONS

- i. Material: Pipe, duct and cable sealing in control layers
- ii. Manufacturer: ProClima or approved equal.
- iii. Product: ROFLEX and KAGLEX gaskets and associated tapes as needed.
- iv. Location: At continuously air-sealed enclosure, to meet the minimum air-leakage requirement. Locations therefore include but are not limited to all fenestration, MEP openings, sub-slab and sub-slab to walls, walls to roof, roof to all roof penetrations and any other exterior assemblies in and of themselves and to all adjacent assemblies.

L. MISCELLANEOUS MATERIALS

- i. Product: Adhesives and/or tapes as specified by manufacturer for listed products.
- ii. Product: Neoprene boots (and associated tape) as required to accommodate stack expansion and contraction. Note this will require close coordination with plumbing subcontractors to ensure appropriate sequencing for inclusion.
- iii. Product: Acoustical Sealant- joint sealant for interior gaps under ¼". Low-VOC products for any/all interior applications is preferred.
- iv. Product: Fiberglass mesh Insect screen. Install as shown on details at the top and bottom of all rain-screen vent cavities. For bottom of cavities, install continuous along cavity by pinching back of screen between strapping and wall insulation, wrapping around the bottom of the strapping, and stapling to the face of the strapping. For top of cavities, staple continuous strip over strapping across area intended to be open for venting.

4. EXECUTION & QUALITY CONTROL

Careful attention to sealing seams and penetrations in air and vapor control layers is important for preventing air leakage and vapor transmission across the building envelope. Store and install according to manufacturer's written instructions unless indicated otherwise.

A. GENERAL

- i. See Sequence of Operations noted on the Drawings for installation procedures for each air/vapor barrier system. Install joint sealants and treatments and transition strips per manufacturer's written instructions.

B. LOOK-AHEAD SCHEDULING AND PREINSTALLATION CONFERENCE

- i. Contractor to include key milestones for control layer and insulation work on the project schedule and to provide ample notice to the architect, envelope commissioning agent, relevant contractors and other appropriate parties. Such milestones shall include as a minimum:
  - a. Pre-installation conference

- b. Submittal and compatibility matrix schedule and review
  - c. Mock-ups required and timing for review and follow-up
  - d. Initial testing, progress testing and final testing milestones for insulation and control layer inspection (see also Section 4.E.i. below)
  - ii. Superintendent to facilitate pre-installation conference with architect, Clerk of the Works, envelope commissioning agent, relevant contractors including representation from MEP trades, and other parties as appropriate prior to work beginning. Pre-installation conference shall include review of building envelope drawings and discussion of the required mock-ups.
  - iii. Perform pre-installation conference with all installers associated with the building envelope and before constructing wall mockups.
- C. PREPARATION
- i. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
    - a. Verify that substrates are free of oil, grease, dirt and other contaminants.
    - b. Verify that concrete is visibly dry and free of moisture and has cured for minimum time period recommended by air-barrier manufacturer.
- D. PERFORMANCE REQUIREMENTS
- i. General: Exterior air/vapor barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration.
  - ii. Air/vapor-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
  - iii. Air/Vapor-Barrier Assembly Air Leakage at new construction: See target noted at the beginning of this spec section for project specific requirement.
- E. FIELD QUALITY CONTROL
- i. Inspections:
    - a. Air/vapor-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Notify architect before starting critical air sealing steps and as specified below.
    - b. Inspections will include the following:
      - 1. Continuity of air/vapor-barrier system has been achieved throughout the applicable areas of building envelope with no gaps or holes.
      - 2. Continuous structural support of air/vapor-barrier system has been provided.
      - 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
      - 4. Site conditions for application temperature and dryness of substrates have been maintained.
      - 5. Maximum exposure time of materials to UV deterioration has not been exceeded.



6. Surfaces have been primed, if applicable.
  7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
  8. Termination mastic or tape has been applied on cut edge per manufacturers' requirements.
  9. Strips and transition strips have been firmly adhered to substrate with appropriate application pressure.
  10. Compatible materials have been used. (Compatibility matrix is required for inclusion with submittal.)
  11. Transitions at changes in direction and structural support at gaps have been provided.
  12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
  13. All penetrations have been sealed.
- c. Testing: The Contractor shall schedule first instance testing with the Owner's testing agency. Depending on schedule, full compliance testing may not be possible to achieve when the building is totally enclosed, fully insulated, air barrier is installed and completed, window and doors are installed, and all items penetrating the building envelope are installed, but before any interior trim work or interior floor and ceiling finishes have been installed, therefore first instance testing and progress testing are more likely the path to compliance. Coordination and timing of testing to be coordinated and confirmed with the architect. The Architect and Owner shall be informed of the testing date two weeks in advance.
1. Qualitative Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage with smoke pencil and/or infrared camera with pressurization or depressurization.
  2. Quantitative Air-Leakage Testing: Blower Door Test to comply with performance requirements.
  3. Repair or remove and replace deficient air-barrier components for retesting as specified above.
  4. Final Testing upon completion of the project to confirm that the project is in compliance with the CBES.

**F. INSTALLATION OF AIR/VAPOR CONTROL LAYERS**

- i. Extend air/vapor control layers to extremities of areas to be protected from air/vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend air/vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation. (See drawings.)
- ii. Seal vertical joints in air/vapor control layers over framing by lapping not less than two wall studs. Fasten air/vapor control layers to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c. Tape all overlaps. Locate all joints on top of solid substrate. Use a PRESSFIX tape pressurization tool to ensure there is sufficient back-pressure when applying the pressure sensitive Pro Clima tapes. Make sure that tape joints are not permanently

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- under stress, i.e. are supported by a batten or by cross taping the taped joint with 12" long pieces of tape every 12"
- iv. Firmly attach air/vapor control layers to solid substrates with appropriate fasteners as recommended by air/vapor control layers manufacturer.
  - v. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating air and vapor control layers as required by air/vapor control layers manufacture's specifications, to meet testing targets and as described in this section.
  - vi. Repair tears or punctures in vapor retarders immediately before concealment by other work. Seal with appropriate tape or another layer of air/vapor control.
- A. SUB-SLAB VAPOR BARRIER
- i. Overlap seams a minimum of 6" and tape using Stego tape.
  - ii. Allow at least 24" overhang at edge of slab to allow wrapping from perimeter of slab up to wall sheathing and fastening with wall air/vapor control layers.
  - iii. Use cut pieces of Stego Wrap, Stego tape and Stego mastic to fully seal around column openings and other openings or punctures through vapor barrier.
  - iv. Provide continuous waterproofing at elevator pit. See drawings and associated spec section.
  - v. Architect shall review vapor barrier installation before slab pour.
  - vi. Sub-slab barrier shall be taped to wall control layers as shown on the drawings.
- G. CONNECTIONS
- i. As per drawings and manufacturers' specifications and installation instructions. Any discrepancy between drawings and manufacturers' specifications and installation instructions shall be brought to the attention of the Architect prior to installation.
  - ii. Provide compatibility matrix showing compatibility of all materials in contact.
- H. ROOF AIR-SEALING
- i. Where plumbing, HVAC, or other items penetrate the air barrier, use a taped neoprene boot or appropriate tape method to seal the gap around the stack while permitting movement due to stack expansion or contraction.
  - ii. Note air/vapor control layer continuity as per drawings.
- I. PROTECTION
- i. Protect air/vapor control layers: If exposed to UV light and harmful weather exposure for more than the maximum allowed by manufacturer, remove and replace air/vapor control layer or install additional, full-thickness, air/vapor barrier application after repairing and preparing the overexposed membrane according to manufacturer's written instructions.
  - ii. Clean construction spills and remove masking materials after installation.
  - iii. Protect air/vapor barrier from contact with incompatible materials and sealants not approved by air/vapor control manufacturer.

END SECTION 072500 KUA ENVELOPE CONTROL LAYERS

**073113 KUA ASPHALT ROOFING**

1. SUMMARY

This section identifies the asphalt shingle roofing and underlayment for the main sloped portions of the building roof. We intend to match the color of the existing asphalt shingle roof.

Related Sections:

- 061000 Rough Carpentry (Structural)
- 062013 Exterior Finish Carpentry
- 072100 Thermal Insulation
- 072500 Envelope Control Layers
- 076100 Standing Seam Metal Roofing and Accessories
- 076200 Sheet Metal Flashing and Trim
- 077200 Roofing Accessories

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	-
Product Cut Sheets	X	- For each listed product - Manufacturer's data sheets - Roofing contractor installation authorization - Solar Reflectance Index (SRI) - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	NA	Asphalt Shingle and Trim for Color Matching (24" x 24" sample min.) Self-Adhered Underlayment
Mock-ups	NA	
Closeout submittals	X	Warranty Information. Manufacturer's final inspection report

3. PRODUCTS

A. ASPHALT ROOFING

- i. Manufacturer: Match existing, IKO, GAF, Certainteed or approved equal.
- ii. Product: Match existing or IKO Cambridge architectural shingles, GAF Timberline HD shingles, Certainteed Landmark series or approved equal.
- iii. Color: Match existing.
- iv. Fire Resistance: Class "A".
- v. Performance: Class D 90 mph wind-uplift resistance minimum.
- vi. Weight: 230 lbs/square min.
- vii. Warranty: Lifetime limited warranty on shingle, 10 year labor, materials, algae and tear-off warranty.
- viii. Solar Reflectance Index: 29, minimum.
- ix. Recycling: Prefer manufacturer to have a take back/recycle program at end of shingle life.

**B. SHEET UNDERLAYMENT**

- i. Manufacturer: Rosenlew RKW Finland Ltd. or approved equal.
- ii. Product: Roof Top Guard II – 5 ply polyethylene and polypropylene laminated vapor barrier roofing underlayment.
- iii. Size and Finish: 60" wide x 200' rolls.
- iv. Location: Under asphalt roofing except where Ice and Water Shield is specified.
- v. Warranty: Fifty (50) year limited material warranty.

**C. SELF-ADHERING SHEET UNDERLAYMENT**

- i. Manufacturer: W.R. Grace Co. or approved equal.
- ii. Product: Ice and Water Shield
- iii. Dimension: 3 foot wide rolls.
- iv. Location: At eaves, valleys, tie in with existing roof, and adjacent to walls.

**D. PIPE BOOT AT PENETRATIONS**

- i. Product: Premolded, EPDM or rubber pipe collar with flexible aluminum ring bonded to base.

**E. ROOFING NAILS**

- i. ASTM F1667, Type I, Style 20, galvanized steel, deformed shanks, heads 10 mm to 11 mm (3/8 inch to 7/16 inch) diameter.
  - a. Nails for Shingles: 32 mm (1-1/4 inches) long, per roofing specification.
  - b. Nails for Underlayment: 19 mm (3/4 inch) long, or per underlayment specification.

**F. METAL FLASHING**

- i. Manufacturer: Englert or Approved Equal (some accessories may be custom-fabricated by roofing installer).
- ii. Products: Flashings, Valley and Trim installed per manufacturer's instructions and recommended practices.
  - a. Provide metal valley flashings with center diverter and 24" extension each side, with 12" min. exposed metal below asphalt shingles.
  - b. Provide metal roof flashings, including apron flashings, step flashings, drip edges, and vent pipe flashings.

**G. RIDGE VENTS**

- i. Ridge Vents: Manufacturer's standard ridge vent for use under asphalt shingles.
  - a. Provide ridge vents with internal filters, internal baffles, or external baffles, for weather protection.
  - b. Free Area: Minimum 25,400 sq. mm per m (12 sq. inches per foot).

**H. RAIN DIVERTER**

- i. Stainless steel or aluminum designed for use with asphalt shingles.

- I. SNOW GUARDS
  - i. See 077200 Roofing Accessories

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. PREPARATION

- i. Examine and verify substrate suitability for roofing installation.
  - a. Verify roof substrates are sound, within manufacturer's tolerances, and free from defects which would interfere with roofing installation.
  - b. Verify roof accessories, vent pipes and other projections through roof are in place and roof flashing is installed, or ready for installation, before installing shingles.
- ii. Clean substrates prior to installation.
- iii. Protect existing construction and completed work from damage.

B. INSTALLATION - GENERAL

- i. Install products according to manufacturer's instructions and approved submittal drawings.
  - a. When manufacturer's instructions deviate from specifications, submit proposed resolution for CM/Architect/Owner consideration.

C. METAL DRIP EDGE INSTALLATION

- i. At eaves and rakes, install stainless steel drip edges
  - a. Eaves: Install metal drip edge before underlayment.
  - b. Rakes: Install metal drip edge after underlayment.
- ii. Secure metal drip edges with compatible nails spaced maximum 250 mm (10 inches) on center along inner edges.

D. FLASHING INSTALLATION

- i. Install metal flashings at intersections of roofs, adjoining walls, or projections through deck such as chimneys and vent stacks.
  - a. Secure valley flashing according to shingle manufacturer's instructions.
  - b. Expose flashing in open portion of valley 125 mm (5 inches) minimum, and lap shingles over flashing 125 mm (5 inches) minimum.

E. INSTALLATION

- i. Install per manufacturer's requirements and below. When manufacturer's instructions deviate from specifications, submit proposed resolution for CM/Architect/Owner consideration.
- ii. Install self-adhering sheet underlayment, working from low point to high point. Lap sides 90 mm (4 inches) minimum, and lap ends 150 mm (6 inches) minimum.
  - a. Eaves and Rakes: From edge of eave and rake to 600 mm (24 inches) minimum beyond inside face of exterior wall.
  - b. Lap underlayment over eave metal drip edge.
  - c. Valleys: Metal valleys extend a minimum 450 mm (18 inches) both sides.

- d. Hips and Roof Slope Transitions: Centered over change in slope, and extended 450 mm (18 inches) minimum on both sides.
  - e. Ridges: Centered on ridge, and extended 900 mm (36 inches) minimum on both sides. // Do not cover ridge vent opening. //
  - f. Sidewalls and Projections through Roof: Extended 450 mm (18 inches) from projection, and extended up projection 100 mm (4 inches) minimum.
  - g. Firmly roll underlayment to ensure adhesion to roof deck and metal flashings.
  - h. Install underlayment on roof deck not covered by self-adhering sheet underlayment, with 100 mm (4 inches) minimum end laps, 50 mm (2 inches) minimum head laps, and 300 mm (12 inches) minimum ridge laps. Nail felt 125 mm (5 inches) on centers along laps.
- iii. Begin with starter strip over galvanized/painted metal edge.
  - iv. Take recommended cold or hot weather precautions to prevent damage and breakage to shingles.
  - v. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed to temporarily close the membrane to prevent water infiltration.

END SECTION 073113 KUA ASPHALT ROOFING

**074600 KUA SIDING**

1. SUMMARY

This section includes fiber cement lap siding, which is an alternate to wood siding (section 074623). In addition, this section addresses the fasteners, finishes, associated sealants, and best practices for installation.

Related Sections:

- 061000 Rough Carpentry
- 061010 Rough Carpentry (Architectural)
- 062013 Exterior Finish Carpentry
- 072500 Envelope Control Layers
- 079200 Joint Sealants
- 099113 Exterior Painting and Staining

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	-
Product Cut Sheets	X	- For each listed product including individual components and finishes. - siding contractor installation authorization - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	- Full set of factory color samples -
Mock-ups	NA	
Closeout submittals	X	Warranty Information and maintenance information

3. PRODUCTS

A. FIBER-CEMENT LAP (Clapboard) SIDING

- i. Manufacturer: James Hardie Building Products, or approved equal
- ii. Product: Horizontal smooth lap side, 4" exposed to weather (4" course)
- iii. Finish: Factory-applied exterior paint - Colorplus Technology
  - a. Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping
- iv. Color: Selected by architect from manufacturer's standard colors
- v. Fasteners: Corrosion resistant siding nails or screws, in concert with manufacturers installation instructions. Vertical fastening no greater than 16" O.C.
- vi. Warranty: Provide twenty (20) year Warranty on materials and workmanship from date of Substantial Completion. Provide fifteen (15) year warranty on finish (peeling, cracking, chipping) from date of material purchase.

B. WOOD SHIP-LAP SIDING (ACCENT)

- i. Product: James Hardie Fiber Cement Artisan Shiplap Siding Primed
- ii. Dimension: 10.25"x144"
- iii. Finish: Primed, painted, with knots pretreated. See 099113 EXTERIOR PAINTING.
- iv. Fasteners: Corrosion resistant trim-head screws, in concert with manufacturers installation instructions.
- v. Installation: Nickel gap horizontal installation with metal corner trim.

A. METAL CORNER TRIM AT ACCENT SIDING

- i. Manufacturer: Fry Reglet OAE
- ii. Product: Aluminum "X" corner profile OC23.
- iii. Color: As chosen by architect from standard color selection.
- iv. Fabrication: Shop fabricated. Coordinate with architectural drawings.

C. SHEET METAL FLASHINGS AND TRIM

- i. Manufacturer: n/a
- ii. Product: Provide painted metal z-flashing at window head trim or any other location where lap siding intersects adjacent horizontal trim or building element.

D. GENERAL MISCELLANEOUS MATERIALS

- i. Product: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for a complete siding system and as recommended by siding manufacturer.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. QUALITY ASSURANCE

- i. Meet with General Contractor, Owner Representative, Architect, and siding installer. Review and finalize construction schedule; availability of materials, methods and procedures; flashing, details and penetrations; temporary protection requirements during and after siding installation.

B. EXAMINATION AND PREPARATION

- i. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances, siding panel supports, and other conditions affecting performance of the Work.
- ii. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal siding panel manufacturer.
- iii. Clean substrates of substances harmful to installation, including removing projections capable of interfering with panel attachment.

C. INSTALLATION



- i. General: Comply with all of siding manufacturer's written installation instructions/
  - ii. Prepare the substrate for siding application.
  - iii. Install ventilated breathable water resistive layer
  - iv. End lap all flashing and trim at least 3".
- D. TOUCH-UP
- i. Use touch up paint provided by siding manufacturer.
- E. CLEANING
- i. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END SECTION 074600 KUA SIDING

**076100 KUA STANDING SEAM METAL ROOFING AND ACCESSORIES**

1. SUMMARY

This section identifies the standing seam metal roofing and other accessories required for installation at the new porch roofs. In addition, this section addresses the fasteners, finishes, associated sealants, and best practices for installation.

Related Sections:

- 055000 Metal Fabrications
- 061010 Rough Carpentry (Architectural)
- 062013 Exterior Finish Carpentry
- 072500 Envelope Control Layers
- 073100 Slate Roof Repair and Cladding
- 073113 Asphalt Roofing
- 076200 Sheet Metal Flashing and Trim
- 077000 Roofing Accessories
- 079100 Movement Joints and Sealants
- 079200 Joint Sealants
- 099113 Exterior Painting and Staining

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Fabrication and installation layouts and details of flashing, trim, fasteners, cleats, clips and other attachments including plans, expansion joint locations, details distinguishing shop and field-assembled work, details of roof penetrations, edge conditions, sidewalls, snow guards, ridge caps, valleys, and transition flashing.
Compatibility Matrix	X	- Provide confirmation of product compatibility with adjacent products. - No enclosure submittals will be approved until this matrix is submitted.
Product Cut Sheets	X	- For each listed product including individual components and finishes. - Roofing contractor installation authorization - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	- Factory applied color samples of metal panel - Sheet metal flashings, fasteners
Mock-ups	X	- Min 3 pans 3' long, including trims, terminations, flashings, penetrations, etc. On-structure mock-up is acceptable.
Closeout submittals	X	- Warranty Information and O & M Information

3. PRODUCTS

A. STANDING SEAM METAL ROOFING

- i. Manufacturer: Englert or approved equal.
- ii. Material: Metallic-Coated Steel Sheet
- iii. Product: 24 gauge aluminum-Zinc Alloy-Coated Steel Sheet.
- iv. Size and Finish: Double lock standing seam, max. 20" wide finished panels, smooth, flat panels.
- v. Performance: Assemblies to comply with UL 580, Class 90 wind-uplift resistance.
- vi. Finish: Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - a. Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping
- vii. Color: As selected from the manufacturer's full range.
- viii. Warranty: Provide twenty (20) year Warranty on finish, two (2) year labor and materials warranty and twenty (20) year warranty for weather tightness from date of Substantial Completion.

A. SELF-ADHERING SHEET UNDERLAYMENT

- i. Manufacturer: GCP Applied Technologies, Englert or approved equal.
- ii. Product: Grace Ultra, MetalMan HT or approved equal. (RoofTopGuard SA)
- iii. Dimension: 3 foot wide rolls.
- iv. Locations: At all valleys, headwalls, sidewalls, and eaves and where roofs meet adjacent building elements. Provide one 3'-0" band at all eaves.

B. HI-PERFORMANCE ROOFING UNDERLAYMENT

- i. Manufacturer: RKW Finland (now Underlayment Specialties Plus) or approved equal.
- ii. Product: RoofTopGuard II, 5 ply polyethylene and polypropylene laminated vapor barrier roofing underlayment.
- iii. Size and Finish: 60" wide x 200' rolls.
- iv. Location: Under standing-seam metal roofing except where Ice and Water Shield is specified.
- v. Warranty: Fifty (50) year limited material warranty.

C. SHEET METAL FLASHINGS AND TRIM

- i. Manufacturer: Use sheet metal to match roofing panels. Min. 24 gauge. As furnished by metal roofing manufacturer.
- ii. Product: Drip edge, rake and eave locations, copings, rain diverters, headwall flashing, sidewall flashings, built-in gutters, step flashing, valley flashings, and miscellaneous flashings and trim, of same sheet metal as roof panels.
  - a. At standing seam valleys provide continuous valley flashing material. Standing seam panels to be held back from centerline of valley a min of 12" each side, and overlap valley flashing by a min of 6", each side. Provide panel joint sealers and fastening, per manufacturer's instructions.

- D. PIPE BOOT AT PENETRATIONS (if needed)
  - i. Product: Premolded, EPDM or rubber pipe collar with Metallic-Coated Steel Sheet ring bonded to base.
- E. GENERAL MISCELLANEOUS MATERIALS
  - i. Product: Provide materials and types of fasteners, protective coatings, separators, sealants, ridge vent, and other miscellaneous items as required for a complete roofing system and as recommended by fabricator for sheet metal roofing.
- F. BRAKE METAL FLASHINGS AND TRIM – See 076200 Sheet Metal Flashing and Trim
- G. SNOW GUARDS – See Section 077000 Roofing Accessories

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

- A. QUALITY ASSURANCE
  - i. Fabricator Qualifications: Provide record of successful in-service performance.
  - ii. UL-Certified Roll-Forming Equipment: Install on-site, roll-formed sheet metal roofing fabricated from UL-certified equipment to comply with equipment manufacturer's written instructions for UL wind-uplift resistance class indicated. Provide sheet metal roofing of full length from eave to ridge unless otherwise restricted by on-site or shipping limitations.
  - iii. Preinstallation Conference:
    - a. Meet with Construction Manager, Owner Representative, Architect, and sheet metal roofing installer. Review and finalize construction schedule; availability of materials, methods and procedures; flashing, details and roof penetrations; temporary protection requirements during and after roof installation.
- B. EXAMINATION AND PREPARATION
  - i. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.
  - ii. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
  - iii. Clean substrates of substances harmful to installation, including removing projections capable of interfering with panel attachment.
- C. INSTALLATION
  - i. Standing-Seam Sheet Metal Roofing: Fasten sheet metal roofing to supports with concealed clips at each seam joint at location, at spacing, and with fasteners recommended by manufacturer of portable roll-forming equipment.
  - ii. The seam shall be equidistant and shall align for corners, hips, valleys, mullions, and columns in accordance with architectural design parameters as shown on the drawing.

- iii. All panels shall be continuous from ridge to eaves with no horizontal end laps.
  - iv. End lap all flashing and trim at least 3".
  - v. Pipe Flashing: Form flashing around pipe penetration and sheet metal roofing. Fasten and seal to sheet metal roofing as recommended by SMACNA.
  - vi. Bar Type Snow Guards: Bar-Type Snow Guards: Attach bar supports to vertical ribs of standing-seam metal roof panels with set screws. Do not use fasteners that will penetrate metal roof panels.
- D. CLEANING
- i. Clean off excess sealants and clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
  - ii. Touch up all minor scratches and spots.

END SECTION 076100 KUA STANDING SEAM METAL ROOFING AND ACCESSORIES

**076200 KUA SHEET METAL FLASHING AND TRIM**

1. SUMMARY

This section includes metal copings, drip edges, and other sheet metal flashings not identified elsewhere in the project manual.

Related Sections:

- 061000 Rough Carpentry (Architectural)
- 064013 Exterior Architectural Woodwork
- 072500 Envelope Control Layers
- 073113 Asphalt Metal Roofing
- 076200 Standing Seam Metal Roofing and Accessories

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Highlight locations and different profiles to be used.
Product Cut Sheets	X	- For each listed product including individual components and finishes. - Roofing contractor installation authorization - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	Metal with Kynar Finish Color Options
Mock-ups	NA	
Closeout submittals	NA	

3. PRODUCTS

A. METALLIC-COATED STEEL SHEET

- i. Manufacturer: Englert or approved equal to match standing seam metal roofing.
- ii. Product: 24 gauge aluminum-Zinc Alloy-Coated Steel Sheet.
- iii. Finish: Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - a. Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping
- iv. Color: As selected from the manufacturer's full range.
- v. Warranty: Provide twenty (10) year Warranty on finish, two (2) year labor and materials from date of Substantial Completion.
- vi. Fabrication: As appropriate for the piece.
  - a. Valleys at asphalt roofing:

B. BREAK METAL CUSTOM BENT WINDOW SILLS

- i. Manufacturer: Englert or approved equal
- ii. Product: 12 gauge aluminum-Zinc Alloy-Coated Steel Sheet.
- iii. Finish: Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - a. Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping
- iv. Color: As selected from the manufacturer's full range.
- v. Warranty: Provide twenty (10) year Warranty on finish, two (2) year labor and materials from date of Substantial Completion.
- vi. Fabrication: Shop fabricated. Dimensions as shown on the drawings.

**C. GENERAL MISCELLANEOUS MATERIALS**

- i. Product: Provide materials and types of fasteners, protective coatings, separators, sealants, ridge vent, and other miscellaneous items as required for a complete roofing systems and as recommended by fabricator for TPO and asphalt roofing.

**4. EXECUTION & QUALITY CONTROL**

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

**A. QUALITY ASSURANCE**

- i. Fabricator Qualifications: Provide record of successful in-service performance.
- ii. Preinstallation Conference:
  - a. Meet with General Contractor, Owner Representative, Architect, and roofing installers. Review and finalize construction schedule; availability of materials, methods and procedures; flashing, details and roof penetrations; temporary protection requirements during and after roof installation.

**B. EXAMINATION AND PREPARATION**

- i. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.
- ii. Clean substrates of substances harmful to installation, including removing projections capable of interfering with panel attachment.

**C. INSTALLATION**

- i. End lap all flashing and trim at least 3".
- ii. Pipe Flashing: Form flashing around pipe penetration and sheet metal roofing. Fasten and seal to sheet metal roofing as recommended by SMACNA.

**D. CLEANING**

- i. Clean off excess sealants and clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- ii. Touch up all minor scratches and spots.

END SECTION 076200 KUA SHEET METAL FLASHING AND TRIM



**077200 KUA ROOFING ACCESSORIES**

1. SUMMARY

This section identifies the gutters and other roof accessories. In addition, this section addresses the fasteners, finishes, associated sealants, and best practices for installation.

Related Sections:

- 055000 Metal Fabrications
- 061000 Rough Carpentry (Architectural)
- 072500 Envelope Control Layers
- 073113 Asphalt Roofing
- 076100 Standing Seam Metal Roofing and Accessories

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Fabrication and installation layouts of flashing, trim, fasteners, cleats, clips and other attachments including plans, expansion joint locations, details distinguishing shop and field-assembled work, details of roof penetrations, edge conditions, snow guards, ridge caps.
Product Cut Sheets	X	- For each listed product including individual components and finishes. - Roofing contractor installation authorization - Snowguards: Submit manufacturer's specifications, standard detail drawings, installation instructions, and recommended layout. - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	- Factory applied color samples of metal panel, snow guard
Mock-ups	NA	- Downspout components - Copper flashing - On-structure mock-ups are acceptable
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

A. SNOW GUARDS

- i. Manufacturer: Alpine Snowguards, Mullane, Fitrite, OAE
- ii. Product:
  - a. At standing seam roofing: Two pipe snow guard that does not penetrate the roof using clamp-to seam technology. Provide complete system with brackets, tubing, couplings, end caps, collars, fasteners, etc.
  - b. At asphalt roofing: Two pipe snow guard designed for asphalt roofing. Provide complete system with brackets, tubing, couplings, end caps, collars, fasteners, etc.

- iii. Material/Finish: color to match standing seam metal roofing – confirm no compatibility concerns with existing materials prior to commencement of work
  - iv. Coordination: Coordinate with the installation of the roof to assure proper placement of the snow guards. Provide appropriate snow guard and fasteners for the roof system.
  - v. Design:
    - a. Spacing to be recommended by manufacturer and submitted for review by engineer.
    - b. Install set screws per snow guard, per manufacturer’s requirements.
  - vi. Installation: Per manufacturer’s requirements
- B. PIPE BOOT AT PENETRATIONS - SEE SEPARATE ROOFING SPECIFICATION SECTIONS FOR REQUIREMENTS AT SLATE, METAL AND ASPHALT ROOFING.
- C. BREAK METAL CUSTOM BENT INTERNAL GUTTERS
- i. Manufacturer: to match standing seam metal roofing
  - ii. Product: 12 gauge painted metal
  - iii. Finish: Kynar Finish from full range of Manufacturer’s standard colors.
  - iv. Fabrication: Shop fabricated. Dimensions as shown on the drawings.
- D. RAIN CHAIN AT CUSTOM GUTTERS
- i. Manufacturer: [https://www.rainchainsinanutshell.com/products/double-loops-rain-chain?variant=32015320416333&gclid=CjwKCAjwolqhBhAGEiwArXT7K\\_G5f8DmUlcjWJxWpLY2\\_75j\\_tNHqHH4GkXO0VGBpU6A78H6LZSXRxoC2BMQAvD\\_BwE](https://www.rainchainsinanutshell.com/products/double-loops-rain-chain?variant=32015320416333&gclid=CjwKCAjwolqhBhAGEiwArXT7K_G5f8DmUlcjWJxWpLY2_75j_tNHqHH4GkXO0VGBpU6A78H6LZSXRxoC2BMQAvD_BwE) or equal.
  - ii. Product: Decorative copper rain chain with loops.
  - iii. Location: Three locations, approximately 10’ long at each.
  - iv. Finish: Copper or as chosen by owner.
  - v. Accessories: Hanger and bottom tie.
- E. SOFFIT VENT
- i. Product: 2” aluminum continuous vent, painted
  - ii. Free Area: Minimum 25,400 sq. mm per m (12 sq. inches per foot).
- F. GENERAL MISCELLANEOUS MATERIALS
- i. Product: Provide materials and types of fasteners, protective coatings, separators, sealants, ridge vent, and other miscellaneous items as required for a complete roofing system and as recommended by fabricator for sheet metal roofing.
4. EXECUTION & QUALITY CONTROL
- Store and install according to manufacturer's written instructions unless specifically noted otherwise.
- A. QUALITY ASSURANCE
- i. Fabricator Qualifications: Provide record of successful in-service performance.
  - ii. UL-Certified Roll-Forming Equipment: Install on-site, roll-formed sheet metal roofing fabricated from UL-certified equipment to comply with equipment manufacturer's written instructions for UL wind-uplift resistance class indicated. Provide sheet metal

roofing of full length from eave to ridge unless otherwise restricted by on-site or shipping limitations.

iii. Preinstallation Conference:

- a. Meet with General Contractor, Owner Representative, Architect, and sheet metal roofing installer. Review and finalize construction schedule; availability of materials, methods and procedures; flashing, details and roof penetrations; temporary protection requirements during and after roof installation.

**B. EXAMINATION AND PREPARATION**

- i. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.
- ii. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
- iii. Clean substrates of substances harmful to installation, including removing projections capable of interfering with panel attachment.

**C. INSTALLATION**

- i. Standing-Seam Sheet Metal Roofing: Fasten sheet metal roofing to supports with concealed clips at each standing-seam joint at location, at spacing, and with fasteners recommended by manufacturer of portable roll-forming equipment.
- ii. The standing seam shall be equidistant and shall align for corners, hips, valleys, mullions, and columns in accordance with architectural design parameters as shown on the drawing.
- iii. All panels shall be continuous from ridge to eaves with no horizontal end laps.
- iv. End lap all flashing and trim at least 3".
- v. Pipe Flashing: Form flashing around pipe penetration and sheet metal roofing. Fasten and seal to sheet metal roofing as recommended by SMACNA.
- vi. Bar Type Snow Guards: Bar-Type Snow Guards: Attach bar supports to vertical ribs of standing-seam metal roof panels with set screws. Do not use fasteners that will penetrate metal roof panels.

**D. CLEANING**

- i. Clean off excess sealants and clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- ii. Touch up all minor scratches and spots.

END SECTION 077200 KUA ROOFING ACCESSORIES

**078400 KUA FIRE-RESISTIVE JOINT SYSTEMS AND PENETRATION FIRESTOPPING**

1. SUMMARY

This section identifies the fire-resistive joint systems in and between fire-resistance rated construction and as the fire stopping of penetrations at interior fire-resistance rated walls, smoke barriers and horizontal assemblies of the building. In addition, this section addresses the fabrication, fasteners, finishes and best practices for installation.

Related Sections:

- 033000 Cast-in-Place Concrete- See Structural Drawings
- 061000 Rough Carpentry (Architectural)
- 061010 Rough Carpentry (Structural)
- 072500 Envelope Control Layers
- 092900 Gypsum Board
- 099123 Interior Painting and Staining

Related Drawing Information:

See Structural and MEP/FP drawings for penetrations and fire-resistance requirements.  
See Architectural Egress Plans, floor plans, RCPs, and partition types for locations of fire rated assemblies.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	- Schedule including location and qualified design for each fire-resistive system.
Product Cut Sheets	X	- For each listed product - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Compatibility Matrix	X	- Provide confirmation of control layer and adhesive product compatibility with adjacent products, see Section 072500 Envelope Control Layers. - No enclosure submittals will be approved until this matrix is submitted.
Product Samples	NA	
Mock-ups	NA	
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

A. SPRAY-ON FIRESTOPPING

- i. Manufacturer: USG Corporation, Hilti, Tremco Inc., or approved equal.
- ii. Product: CFS SP WB/Firecode brand acrylic firestop spray sealant, type SA.
- iii. Performance: movement capability/deflection over time,
- iv. Color: Red, paintable
- v. Location: Applied to min 1/8" thickness or as indicated by UL assembly.

B. MORTAR TYPE FIRE COMPOUND

- i. Manufacturer: USG Corporation, Hilti, Tremco Inc., or approved equal.
- ii. Product: Firecode Brand Compound.
  - a. Performance: movement capability /deflection over time,
  - b. Color: Red, paintable
- iii. Location: Applied to min 1/2" thickness for 1 hr assembly, 1" thickness for 2 hr assembly, where indicated by UL assembly.

C. ACOUSTICAL SEALANT

- i. Manufacturer: USG Corporation, Hilti, Tremco Inc., or approved equal.
- ii. Product: CP 506/Sheetrock Brand Acoustical Sealant.
- iii. Location: At base and top of acoustical walls as shown on the Drawings. (cannot be used at fire locations unless specifically rated for such use.)

D. INTUMESCENT ACRYLIC SEALANT

- i. Manufacturer: USG Corporation, Hilti, Tremco Inc., or approved equal.
- ii. Product: FS One/Firecode brand acrylic firestop sealant, type IA.
- iii. Location: Applied to min. 1/2" thickness at appropriate penetrations and as indicated by UL assembly.

E. MINERAL WOOL FORMING MATERIAL

- i. Manufacturer: Roxul, Hilti, Thermafiber, Hilti, or approved equal.
- ii. Product: Type SAF or Safe mineral fiber/CP 767/777, 4 pcf min.
- iii. Location: At wall/floor deck joints, door frames and where indicated by UL assembly.

F. FOAM BACKER

- i. Manufacturer: USG, or approved equal.
- ii. Product: Backer Rod
- iii. Location: As indicated by UL assembly.

G. VOC CONTENT LIMITS:

- i. Sealants: 250 g/L
- ii. Sealant primers for non-porous substrates: 250 g/L
- iii. Sealant primers for porous substrates: 775 g/L

H. INTUMESCENT PAINT – SEE SECTION 099123 INTERIOR PAINTING AND STAINING

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. PREPARATION

- i. See Wall types, indicated UL Assemblies, and plan and section details for required locations and applications.

- ii. See mechanical, electrical and plumbing drawings for penetration locations and types.
- B. INSTALLATION**
- i. Do not install when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
  - ii. Clean surfaces immediately before installing firestopping.
  - iii. Prime where recommended by manufacturer.
  - iv. Prepare sample area of joint systems for approval by Architect before proceeding with the work.
- C. IDENTIFICATION**
- i. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
    - ii. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
    - iii. Contractor's name, address, and phone number.
    - iv. Designation of applicable testing and inspecting agency.
    - v. Date of installation.
    - vi. Manufacturer's name.
    - vii. Installer's name.
- D. CLEANING AND PROTECTION**
- i. Remove excess materials and protect work after installation.

END SECTION 078400 KUA FIRE-RESISTIVE JOINT SYSTEMS AND PENETRATION FIRESTOPPING

**081213 KUA HOLLOW METAL DOORS AND FRAMES**

1. SUMMARY

This section identifies the hollow metal doors and frames throughout the project. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

- 081416 Flush Wood Doors
- 087100 Door Hardware
- 088000 Glazing
- 092900 Gypsum Board
- 099113 Exterior Painting
- 099123 Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Elevations and details for each door and frame (including glazing/lites)
Product Cut Sheets	X	- For each listed product and accessory - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples		-
Mock-ups	NA	-
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

A. GENERAL

- i. All vision glass to meet ADA/ABA requirements for distance to finish floor, typ.

B. STANDARD HOLLOW METAL DOORS:

- i. Manufacturer: TBD
- ii. Product: Flush Panel, square edge, Min. 20 gauge steel faces. Comply with ANSI/SDI A250.8.
- iii. Thickness and Edge: 1-3/4 inches thick, edge construction: Model 2, Seamless.
- iv. Interior Doors: Uncoated, cold-rolled steel sheet.
  - a. SDI Standard Duty: Level 1, Performance Level C.
  - b. Uncoated, cold-rolled steel sheet.
  - c. Core: Manufacturer's standard Kraft-paper honeycomb, polystyrene, polyurethane, mineral board or vertical steel stiffener.
- v. Fire-Rated Door Assemblies:
  - a. Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.

- b. Temperature-Rise Limit: At vertical exit enclosures and exit passageways provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
  - c. Glazing Dimension: 100 square inch window maximum at vision lites.  
(configurations to meet ADA/ABA requirements)
  - d. Glazing at laminated glass - See door schedule
  - vi. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet.
    - a. SDI Extra Heavy Duty: Level 3, Performance Level A.
    - b. Provide thermal-resistance value not less than R-4 at exterior doors.
    - c. Core: Manufacturer's standard, polyurethane.
  - vii. Shop Priming: Manufacturer's standard, fast-curing, lead- and chromate-free primer
- C. STANDARD HOLLOW METAL FRAMES
- i. Manufacturer: TBD
  - ii. Product: Hollow Metal Frames
    - a. Interior Frames: Cold-rolled steel sheet.
    - b. Exterior Frames: Thermally broken frames fabricated from metallic-coated steel sheet.
  - iii. Rating: Hollow Metal Frames
    - a. Provide Assembly complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
  - iv. Fabrication:
    - a. Full profile welded frames with mitered corners unless otherwise indicated.
    - b. Minimum .042 inch steel sheet for steel and wood doors and borrowed lights
    - c. Hardware reinforcement plates as required
    - d. Shop Priming: Manufacturer's standard, fast-curing, lead- and chromate-free primer.
    - e. Door Silencers: Except on weather-stripped doors, drill stop in strike jamb to receive three door silencers.
  - v. Throat Size:
    - a. Provide frame throat size ¼" larger than assembly components.
- D. FRAME ANCHORS
- i. Jamb Anchors: Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
  - ii. Floor Anchors: Clip-type anchors formed from same material as frames, not less than 0.042 inch thick, with two holes to receive fasteners.
- E. STOPS AND MOLDINGS
- i. Moldings for Glazed Lights in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
  - ii. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
  - iii. Loose Stops for Glazed Lights in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.
- F. GLAZING FOR BORROWED LITES



- i. Product: ¼" tempered glass.
- ii. Locations: See door and window schedules.

4. EXECUTION & QUALITY CONTROL

Deliver, store and install according to manufacturer's written instructions unless otherwise indicated.

A. PREPARATION

- i. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver items to Project site in time for installation.

B. FABRICATION

- i. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
  - a. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

C. INSTALLATION

- i. Hollow Metal Frames:
  - a. Set frames plumb, aligned and square with no twist- 1/16 inch tolerances.
  - b. At fire-protection-rated openings, install frames according to NFPA 80.
  - c. Install frames with removable glazing stops located on secure side of opening.
  - d. Secure frames appropriately for the wall type.
  - e. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors or powder-actuated fasteners.
  - f. Install door silencers in frames before grouting.
  - g. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames
- ii. Hollow Metal Doors:
  - a. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- iii. Glazing:
  - a. Secure stops with countersunk flat-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

D. ADJUSTING AND CLEANING

- i. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

END SECTION 081213 KUA HOLLOW METAL DOORS AND FRAMES

**081416 KUA FLUSH WOOD DOORS**

1. SUMMARY

This section identifies flush wood doors with or without fire-rating, glazing and/or louvers in the interior of the building. The doors will not contain urea formaldehyde. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

- 062023 Interior Finish Carpentry
- 064023 Interior Architectural Woodwork
- 081113 Hollow Metal Doors and Frames
- 087100 Door Hardware
- 088000 Glazing
- 092900 Gypsum Board

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Location, size, and hand of each door, elevations of each door type (including glazing/lites), locations and extent of hardware blocking.
Product Cut Sheets	X	- For each type of door indicated, including core and edge construction, louvers, and factory-finishing specifications. - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	- Factory finish applied to actual door face materials for each material and finish- approx. 8" x 10" samples. - Louver blade and frame and glazing frame- 6" sample.
Mock-ups	NA	-
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

A. GENERAL

- i. All vision glass to meet ADA requirements for distance to finish floor, typ.

B. VENEER-FACED DOORS FOR TRANSPARENT FINISH

- i. Basis of Design Product: Solid-core doors with wood-veneer faces, factory finished.
  - a. Grade: Heavy Duty, Premium, with Grade AA faces.
  - b. Cut: Rotary cut
  - c. Species: Select Birch
  - d. Match between Veneer Leaves: Book match.
  - e. Assembly of Veneer Leaves on Door Faces: Balance match.
  - f. Special Matching: Pair and set match.
  - g. Core: Particleboard made with binder containing no urea formaldehyde resin.

1. Provide doors with either glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
  2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
  - h. Thickness: 1 3/4" typical, 1 3/8" at residence interiors, or as indicated in door schedule.
  - i. Construction: Five plies, bonded, square edge.
  - j. Adhesives: Type 1 per WDMA TM-6, low VOC, NO urea formaldehyde.
  - k. Louvers, glazing, or undercut as indicated in the Drawings.
    1. All glazing to meet ADA requirements for height and size.
    2. All glazing to meet life safety requirements for location and size.
- C. FIRE-RATED VENEER-FACED DOORS FOR TRANSPARENT FINISH
- i. Manufacturer: Same as other interior doors unless otherwise indicated.
  - ii. Product: Provide core specified or mineral core as needed to provide fire-protection rating indicated, with wood-veneer faces, factory finished.
    - a. Match non-fire-rated doors material and finish.
    - b. Provide positive pressure tested doors.
    - c. Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
    - d. Provide labeling and comply with requirements in NFPA 80.
    - e. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
    - f. 20 Min., 45 Min. or 60 Min. Door: Category A, built in edge sealing, 1 3/4 inch.
    - g. Provide glazing where shown on door schedule.
      1. All glazing to meet ADA requirements for height and size.
      2. All glazing to meet life safety requirements for location and size.
- D. DOORS FOR PAINT FINISH
- i. Product: Solid Core, Primed Smooth MDF door.
    - a. Core and Frame: Solid Particleboard core made with binder containing no urea formaldehyde resin with combination wood/MDF frame.
      1. Thickness: 1 3/4", 1 3/8" at residence interiors, or as noted in door schedule.
      2. Provide doors with either glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
      3. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
    - b. Construction: bonded, square edge.
    - c. Adhesives: Type 1 per WDMA TM-6, low VOC, NO urea formaldehyde.
    - d. Jamb: Primed pine or poplar with no finger-jointing, split jamb, with 5/8" x2 1/2" pre-applied primed casing, Prepared for door hardware.
      1. Jamb depth per wall type.

- e. Finish: Primed MDF.
  - f. Louvers, glazing, or undercut as indicated in the Drawings.
    - 1. All glazing to meet ADA requirements for height and size.
    - 2. All glazing to meet life safety requirements for location and size.
- E. FIRE-RATED VENEER-FACED DOORS FOR PAINT FINISH**
- i. Manufacturer: Same as other interior doors unless otherwise indicated.
  - ii. Product: Provide core specified or mineral core as needed to provide fire-protection rating indicated, with smooth MDF faces, factory finished. Provide rating as indicated in drawings.
    - a. Match non-fire-rated doors material and finish.
    - b. Provide positive pressure tested doors.
    - c. Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
    - d. Provide labeling and comply with requirements in NFPA 80.
    - e. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
    - f. 60 Min. Door: Category A, built in edge sealing, 1 3/4 inch.
    - g. Provide glazing where shown on door schedule and elevations and specified in Section 088000 Glazing.
      - 1. All glazing to meet ADA requirements for height and size.
      - 2. All glazing to meet life safety requirements for location and size.
- F. GLAZING FRAMES AND LOUVERS**
- i. General: Same Manufacturer as door unless otherwise indicated.
  - ii. Louvers: Door standard Reverse "V" solid-wood louvers in same wood species and finish as doors.
  - iii. Glazing frames: Flush Rectangular Wood Beads in same wood species and finish as doors. Sizes as shown on the Drawings.
  - iv. Glazing stops and frames in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated. Metal frame if required for fire-protection rating.
  - v. Standards:
    - a. All glazing/vision panels to meet ADA standards for distance from finish floor to bottom of vision plane, typ.
    - b. All glazing to meet life safety requirements for location and size.
- G. FINISHING**
- i. Manufacturer: As provided by Door Manufacturer.
  - ii. Finish: Premium Grade, AWI System TR-6 catalyzed polyurethane, satin sheen.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless otherwise indicated.

A. FABRICATION

- i. Hardware Preparation: Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates furnished as specified in Division 08 Section "Door Hardware."
- ii. Openings: Cut and trim openings through doors in factory.
  - a. Factory install glazing, louvers and trim when possible.
- iii. Finishing: Factory finish faces, all four edges, edges of cutouts, and mortises.
  - a. Transparent Finish: Premium Grade, AWI System TR-6 catalyzed polyurethane, satin sheen.

B. INSTALLATION

- i. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- ii. Job-Fitted doors: Align and fit doors in frames with uniform clearances and bevels as necessary for proper installation; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  - a. Comply with NFPA 80 for fire-rated doors.
- iii. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- iv. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- v. Adjustments: Rehang or replace doors that do not swing or operate freely.
- vi. For entrance doors accessible to people with disabilities, adjust closers to provide a 5-second closer sweep period for doors to move from a 90-degree open position to 3 inches from the latch, measured to the leading door edge.
- vii. Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END SECTION 081416 KUA FLUSH WOOD DOORS

**081600 KUA EXTERIOR DOORS AND FRAMES**

1. SUMMARY

This section identifies the insulated wood, aluminum-clad wood, fire-rated, and fiberglass doors at the exterior entries of the building. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Questions: all doors in hollow metal frames? Or frames by Door provider? Where insulated metal vs. fiberglass?

Related Sections:

- 08 12 13 Hollow Metal Doors and Frames
- 08 14 16 Flush Wood Doors
- 08 71 00 Door Hardware
- 08 80 00 Glazing
- 09 91 13 Exterior Painting
- 09 91 23 Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Elevations and details for each door and frame
Product Cut Sheets	X	- For each listed product and accessory
Product Samples	X	12" length of Frame material
Mock-ups	NA	
Closeout submittals	X	Warranty Information

3. PRODUCTS

A. STANDARD FIBERGLASS ENTRY DOOR

- i. Manufacturer: Therma-tru, Masonite, or approved equal
- ii. Product: Therma-tru half-light or flush door as indicated in schedule, Smooth Star style S140.
- iii. Comply with ANSI/SDI A250.8.
- iv. Thickness and Edge: 1-3/4 inches thick, edge construction: reinforced pine edge, composite bottom.
- v. Exterior Doors: Face sheets fabricated from 1/16" min. thickness fiberglass reinforced thermoset composite
  - a. Air Leakage at 1.57psf: .5cfm/sf of frame.
  - b. U- Value: U= .28, SHGC= .15, 27"x64" glass size, energy star rated N.
  - c. Core: Manufacturer's standard, polyurethane, 1.9 pcf min.
- vi. Glazing: Double glazed, Low-E clear glass, where indicated on the dwgs.
- vii. Sill: Outswing public access aluminum sill with thermal break

- a. Finish: T.B.D.
  - b. ADA Compliant
  - viii. Hinges, locking hardware: See door hardware spec.
  - ix. Accessories:
    - a. Sill Pan, corner seal pad, rain guard.
  - x. Warranty: 3-year multi-family warranty
  - xi. Shop Priming: Manufacturer's standard,
- B. INSULATED METAL DOORS:**
- i. Manufacturer: TBD
  - ii. Product: Flush Panel, square edge, Min. 18-gauge galvanized steel faces. Comply with ANSI/SDI A250.8.
  - iii. Thickness and Edge: 1-3/4 inches thick, edge construction: Model 2, Seamless.
  - iv. Exterior Doors: galvanized, cold-rolled steel sheet.
    - a. SDI Standard Duty: Level 2, Performance Level B.
    - b. A40 galvanized, 18 ga. cold-rolled steel sheet.
    - c. Core: Manufacturer's standard high density polystyrene core with reinforcement for exit device.
    - d. Air Leakage at 1.57psf: .5cfm/sf of frame.
    - e. U- Value: U= .28, SHGC= .15, 27"x64" glass size, energy star rated N.
    - f. Prep: Cylindrical Lock and three Hinge Prep.
  - v. Fire-Rated Door Assemblies: 90 min.
    - a. Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to ANSI 10C and NFPA 252.
    - b. Temperature-Rise Limit: At vertical exit enclosures and exit passageways provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
    - c. Glazing Dimension: 100 square inch window maximum 6"x27" prep at vision lites. See Glazing 08 80 00.
  - vi. Shop Priming: Manufacturer's standard, fast-curing, lead- and chromate-free primer.
  - vii. Frame: Thermally broken 2" hollow metal frame.
  - viii. Sill: Outswing public access aluminum sill with thermal break
    - a. Finish: T.B.D.
    - b. ADA Compliant
  - ix. Accessories:
    - a. Sill Pan, corner seal pad, rain guard.
- C. ALUMINUM CLAD WOOD ENTRY DOOR**
- i. Manufacturer: Marvin Windows, or approved equal
  - ii. Product: Marvin Elevate swinging French door, outswing at vestibules, in-swing at patios – faculty residences.
  - iii. Comply with ANSI/SDI A250.8.

- a. Thickness and Edge: 1-3/4 inches thick, edge construction: reinforced edge, composite Air Leakage at 1.57psf: .5cfm/sf of frame.
  - b. U- Value: U= .26, SHGC= .15, 27"x64" glass size, energy star rated N. bottom.
  - iv. Exterior Doors:
    - a. Core: Manufacturer's standard, polyurethane, 1.9 pcf min.
  - v. Glazing: Double-glazed at interior vestibules, triple glazed at exterior vestibules and faculty residences. glazed, Low-E clear glass, glass.
  - vi. Frame: Thermally broken 2" frame
  - vii. Sill: Outswing public access aluminum sill with thermal break
    - a. Finish: T.B.D.
  - viii. Transom: Transom to match door- see door schedule for sizes.
  - ix. Hinges, locking hardware: See door hardware spec.
  - x. Accessories:
    - a. Sill Pan, corner seal pad, rain guard.
    - b. ADA Compliant
  - xi. Color: From the standard aluminum cladding colors.
  - xii. Warranty: 3-year multi-family warranty
  - xiii. Shop Priming: Manufacturer's standard clear coat finish on interior.
- D. STANDARD EXTERIOR DOOR FRAMES
- i. Product: Thermally broken hollow metal frame: see 08 12 13 Hollow Metal Doors and Frames.

4. EXECUTION & QUALITY CONTROL

Deliver, store and install according to manufacturer's written instructions unless otherwise indicated.

A. PREPARATION

- i. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver items to Project site in time for installation.

B. FABRICATION

- i. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
  - a. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

C. INSTALLATION

- i. Hollow Metal Frames:



- a. Set frames plumb, aligned, and square with no twist- 1/16 inch tolerances, fastenings per manufacturer's instructions.
    - b. Air Sealing:
  - ii. Composite Frames:
    - a. Set frames plumb, aligned, and square with no twist- 1/16 inch tolerances, fastenings per manufacturer's instructions.
- D. ADJUSTING AND CLEANING
  - i. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including work that is warped, bowed, or otherwise unacceptable.

END SECTION 081600 KUA EXTERIOR DOORS AND FRAMES

**083113 KUA ACCESS DOORS AND FRAMES**

1. SUMMARY

This section identifies the access doors and frames required for accessing portions of the attic as well as mechanical, plumbing and fire protection systems in the building. This section also includes bulkhead doors for exterior basement access. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

061000 Rough Carpentry

092900 Gypsum Board

075423 TPO Roofing

See Reflected Ceiling Plans and Mechanical, Plumbing and Fire Protection Drawings for access door locations.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Elevations, sections, details of each door type, locations and extent of hardware blocking.
Product Cut Sheets	X	- For each type of door and frame indicated.
Product Samples	X	For each door face material. Color options for each product as applicable.
Mock-ups	NA	
Closeout submittals	X	Warranty Information

3. PRODUCTS

A. ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- i. Basis-of-Design Product: Acudor Products, Inc., Flush Drywall Access Doors and removeable panels.
  - a. Size and location: as required- see mechanical drawings.
  - b. Finish: Prime Coated Steel. Field painted finish to match ceilings.
  - c. Lock: Cylinder lock and key, Torx head cam Latch, or Spanner head cam latch.
  - d. Trim: For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
  - e. Fire rating of access door and frame to match rating of ceiling or wall it is installed in.

B. EXTERIOR BASEMENT ACCESS

- i. Manufacturer: Sloped bulkhead door: [www.lucigold.com](http://www.lucigold.com) , or approved equal.
- ii. Product: Sloped bulkhead door with top hinge.
  - a. Size: 7'-0" x 9' – 0". Custom size.

- b. Finish: powder coated by manufacturer- grey – color to be determined by architect)
- c. Lock: open from the inside – no handle on exterior.
- d. Trim: Flanges to come over exterior concrete wall areaway.
- e. Fire rating: None
- f. Slope – 2:1 approximate – per manufacturer’s recommendation.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless otherwise indicated.

A. ACCESS DOORS & PANELS

- i. Install doors in drywall surfaces flush with adjacent finish surfaces before taping to receive finish material.
- ii. Adjust doors and hardware, after installation, for proper operation.

END SECTION 083113 KUA ACCESS DOORS AND FRAMES

**085000 KUA WINDOWS**

1. SUMMARY

This section identifies the new windows in the exterior walls of the building. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Note that this project will be subject to the 2020 Vermont Commercial Building Energy Standards (CBES), and VHCB and VHFA Multifamily Energy Design Standards (March 2012 – Tier II). These regulations stipulate standards for thermal energy performance, as well as air tightness, including the requirement to test the building envelope. The Thermal Insulation, Envelope Control Layers, Joint Sealant, Door specifications, in concert with the architectural drawings, provide additional information and detailing for satisfying these requirements. While the Air Tightness Compliance Testing as noted in the Envelope Control Layer specification provides guidance for the testing process, the Envelope Control Layer specification section specifies goals and requirements for meeting our energy performance target.

Related Sections:

- 061000 Rough Carpentry
- 062013 Exterior Finish Carpentry
- 062023 Interior Finish Carpentry
- 072500 Envelope Control Layers
- 074100 Preformed Metal Wall Panels
- 074600 Exterior Siding
- 088000 Glazing
- 099110 Exterior Painting
- 099123 Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Plans, elevations, sections, details, attachment hardware
Product Cut Sheets	X	- For each listed product - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Compatibility	X	- Provide confirmation of product and accessory product compatibility with adjacent products. -
Product Samples	X	- Window corner section
Mock-ups		- One mock-up of new window illustrating various installation conditions, or first instance testing of each installation condition.
Closeout submittals	X	- Manufacturer's standard warranty Information - Operations & Maintenance Information

3. PRODUCTS

- A. WINDOWS - DOUBLE GLAZED (at vestibules)
  - i. Manufacturer: Basis of design- Marvin Elevate Series.

- 
- a. Other options: Pella, Alpen, Fibertec, or approved equal.
  - ii. Product Basis of Design: Marvin Elevate – Fiberglass Clad Wood Window.
    - a. Casement, Awning, and Fixed: as shown on drawings and schedules.
    - b. Sash and frame cladding material: Fiberglass preferred.
  - iii. Color:
    - a. Exterior-White or bronze fiberglass, Interior- factory finished white or bronze.
  - iv. Thermal Transmittance: Whole window U- factor of .28 or better.
  - v. Glazing:
    - a. 3/4" double-gazed, low-e glass with argon (or argon/krypton mix), U-.28 max. whole window rating.
    - b. Solar Heat Gain Coefficient: .22-.3 whole window rating.
    - c. Warranty Period: 10 years from date of Substantial Completion.
  - vi. Nailing Fin: Factory installed nailing fin at all four sides (air-sealed).
  - vii. Sizes: Standard sizes as shown on the Drawings. (Provide standard size as close to listed sizes as possible unless noted otherwise).
  - viii. Hardware and Accessories:
    - a. Standard Hardware, Color: Bronze
    - b. Standard charcoal fiberglass insect screens.
    - c. Opening limiters or Fall-prevention guards.
  - ix. Performance:
    - a. Meets or exceeds AAMA/WDMA/CSA 101/I.S.2/A440 Ratings: LC-PG30, WDMA Hallmark Certified.
    - b. Unit assembly shall withstand both positive and negative uniform static air pressure difference without damage when tested according to ASTM E 330.
    - c. Air Infiltration at 1.57 psf wind pressure: 0.07 cfm/ft<sup>2</sup> of frame max.
    - d. Water Penetration Resistance: 4 psf min.
- B. WINDOWS- TRIPLE GLAZED (at new and existing buildings)
- i. Manufacturer: Basis of design- Marvin Elevate.
    - a. Other options: Pella 350 or other.
  - ii. Product Basis of Design: Marvin Elevate or Equal
    - a. Double or single-hung, Awning, fixed, and combination: as shown on drawings and schedules. Fiberglass clad wood window.
  - iii. Color:
    - a. Exterior-White or bronze fiberglass, Interior- factory finished white or bronze.
  - iv. Thermal Transmittance: Whole window U- factor of .20 or better.
  - v. Glazing:
    - a. 1-1/4" tri-pane, low-e glass with argon (or argon/krypton mix), U-.18 whole window rating.
    - b. Solar Heat Gain Coefficient: .25-.3 whole window rating.
    - c. Warranty Period: 10 years from date of Substantial Completion.
  - vi. Nailing Fin: Factory installed nailing fin at all four sides.
  - vii. Sizes: Standard sizes as shown on the Drawings. (Provide standard size as close to listed sizes as possible unless noted otherwise).
  - viii. Hardware and Accessories:

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- a. Thermal buck: <https://thermalbuck.com/> size as noted on the drawings, or equal.
  - b. Standard Hardware, Color: White
  - c. Standard insect screens
  - d. Opening limiters or Fall-prevention guards.
  - e. Interior jamb extension – see drawings/window details.
- ix. Performance:
- a. Meets or exceeds AAMA/WDMA/CSA 101/I.S.2/A440 Ratings: LC-PG30, WDMA Hallmark Certified.
  - b. Unit assembly shall withstand both positive and negative uniform static air pressure difference without damage when tested according to ASTM E 330.
  - c. Air Infiltration at 1.57 psf wind pressure: 0.07 cfm/ft<sup>2</sup> of frame max.
  - d. Water Penetration Resistance: 4 psf min.
- C. WINDOWS- TRIPLE GLAZED (at new and existing buildings) ALTERNATE
- i. Manufacturer: Basis of design- Wythe Windows – European Tilt & Turn style.
    - a. Other options: Zola, Logic, or other.
  - ii. Product Basis of Design: Wythe Astor
    - a. Awning, fixed, casement, and combination: as shown on drawings and schedules. PVC-U.
  - iii. Color:
    - a. Standard colors.
  - iv. Thermal Transmittance: Whole window U- factor of .16 or better.
  - v. Glazing:
    - a. 1-1/4" tri-pane, low-e glass with argon (or argon/krypton mix), U-.18 whole window rating.
    - b. Solar Heat Gain Coefficient: .34 whole window rating.
    - c. Warranty Period: 10 years from date of Substantial Completion.
  - vi. Sizes: Standard sizes as shown on the Drawings. (Provide standard size as close to listed sizes as possible unless noted otherwise).
  - vii. Hardware and Accessories:
    - a. Standard Hardware, Color: Black
    - b. Standard insect screens
    - c. Opening limiters or Fall-prevention guards.
    - d. Interior jamb extension – see drawings/window details.
  - viii. Performance:
    - a. Meets or exceeds AAMA/WDMA/CSA 101/I.S.2/A440 Ratings: LC-PG30, WDMA Hallmark Certified.
    - b. Unit assembly shall withstand both positive and negative uniform static air pressure difference without damage when tested according to ASTM E 330.
    - c. Air Infiltration at 1.57 psf wind pressure: 0.07 cfm/ft<sup>2</sup> of frame max.
    - d. Water Penetration Resistance: 4 psf min.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless otherwise indicated.

**A. EXAMINATION**

- i. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify rough opening dimensions, levelness of sill plate, and operational clearances
- ii. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weather-tight window installation.
- iii. Correct unsatisfactory conditions before proceeding with window installation.

**B. INSTALLATION – NEW WINDOWS**

- i. Install window opening flashings in proper sequence with vapor/air barrier assembly.
- ii. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weather tight construction. Follow manufacturer’s recommended installation and fastening instructions.
- iii. Tape window exterior to weather barrier with approved. Tape.
- iv. Seal around window with low expanding spray foam and joint sealants.

**C. TESTING**

- i. Exterior install to be reviewed and tested by Envelope Commissioning Agent. See OPR for targets.

**D. ADJUSTMENT, CLEANING, AND PROTECTION**

- i. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weather tight closure.
- ii. Clean exposed surfaces immediately after installing windows. Keep protective films and coverings in place until final cleaning.

END SECTION 085000 KUA WINDOWS

**087100 KUA DOOR HARDWARE**

1. SUMMARY

This section identifies the door hardware for the exterior and interior doors and accessory hardware of the buildings. See door schedules for hardware locations.

Related Sections:

- 081100 Wood Doors and Frames
- 081113 Hollow Metal Doors and Frames
- 081416 Flush Wood Doors
- 083113 Access Doors and Frames

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X X	- For each product, including locations and schedule - Templates for door and frame fabrication for each product
Product Cut Sheets	X	- For each listed product - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
EPDs/HPDs	X	- for each listed material
Product Samples	X	- hardware finishes
Mock-ups	NA	-
Closeout submittals	X	- Warranty Information, Maintenance information, O & M Information

3. PRODUCTS

- A. INTERIOR AND EXTERIOR DOOR LOCKS AND LEVERS
  - i. Grade: Commercial, Grade 2, medium duty
  - ii. Manufacturer: ~~Allegion~~ Marks USA
  - iii. BOD Product: US Lock 2050C / Sargent 7 Line, Cylinder Locks- 2 1/8" bore, 2 3/4" backset, 1/2" min. bolt throw. Marks B – Entry Push button only.
    - a. Finish: US26D, 626 Satin Chrome
    - b. Lever: L Lever
  - iv. Confirm compatibility with all door thicknesses shown in drawings.
  
- B. FIRE EXIT DEVICES FOR STANDARD DOORS -
  - i. Grade: Commercial, Grade 2, medium duty
  - ii. Manufacturer: Von Duprin QEL for single latching door
  - iii. BOD Product: Von Duprin QEL for single latching door
    - a. Finish: US26D, 626 Satin Chrome
  - iv. Devices complying with NFPA 80.
  - v. Confirm compatibility with all door thicknesses shown in drawings.
  - vi. Strikes:



- 
- a. For single leaf door with rim-latching crash bar, use HES 9600- 9800 series electric strike
  - b. For single leaf door with cylindrical / mortise lever set, use HES 1006 electric strike.
- C. KEYING
- i. Manufacturer: Allegion – PLACEHOLDER – WAITING FOR KUA ALLEGION REP INFO.
  - ii. Cylinders: US Lock 15995-RXO Six-pin Best Cylindrical Lock s with 7- pin small format restricted cylinder stainless steel, manufacturer’s standard tumbler
    - a. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, raised trim ring.
  - iii. Permanent Cores: Manufacturer’s standard lock cylinders, face finished to match lockset, permanent cores that are interchangeable; Core insert, removable by use of a special key, usable with other manufacturer’s cylinders.
  - iv. Construction Keying/Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.
  - v. Keying system: Provide a factory registered keying system complying with the following:
    - a. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
  - vi. Keys: Provide Nickel silver keys complying with the following:
    - a. Stamping: Permanently inscribe each key with a visual key control number and include the following notation: “DO NOT DUPLICATE”.
  - vii. Keypads: Door contacts and security key pads to be provided at locations noted in door schedule by Owner’s security consultant. Coordinate work with owner’s security consultant and provide power and compatible hardware, typical.
- D. ELECTROMAGNETIC FIRE DOOR HOLDER - Allegion – PLACEHOLDER – WAITING FOR KUA ALLEGION REP INFO.
- i. Manufacturer: Sargent Manufacturing, Architectural Builders Hardware, DORMA Architectural Hardware, or approved equal.
  - ii. BOD Product: Surface wall mounted single unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire alarm system for labeled fire-rated door assemblies, with die cast housing. Fail safe magnets hold until current is interrupted.
- E. HINGES AND PIVOTS - PLACEHOLDER – WAITING FOR KUA ALLEGION REP INFO.
- i. Standards: Comply with the appropriate BHMA standard, comply with NFPA 80 at fire-rated doors.
  - ii. Provide three hinges for each door unless noted otherwise.
  - iii. Hinge weight:
    - a. Entrance Doors: Heavy-weight anti-friction bearing hinges.
    - b. Interior Doors: Standard-weight anti-friction bearing hinges.
  - iv. Hinge Base Metal:
    - a. Exterior and Wet Areas: Stainless steel with stainless-steel pin.
    - b. Interior and Fire-rated Assemblies: Steel with steel pin.
  - v. Provide non-removable pins at out-swinging corridor doors with locks.

F. STRIKES

- i. Manufacturer: Von Duprin QEL for single latching door
- ii. BOD Product: Von Duprin QEL for single latching door
  - a. Finish: US26D, 626 Satin Chrome
- iii.

G. CLOSERS - **PLACEHOLDER – WAITING FOR KUA ALLEGION REP INFO.**

- i. Manufacturer: Sargent Manufacturing Company (Assa Abloy), Falcon, OAE
- ii. BOD Product: ~~Falcon SC80A Series~~ **LCN4111** Aluminum Closer, non-handed arm with adjustable forearm assembly. Mounts hinge side, top jamb, or parallel arm. Single piece cast aluminum body. ANSI Grade 1.
- iii. Warranty: 10 years
- iv. Adjustable to meet ADA code required time delays.

H. PROTECTIVE TRIM UNITS

- i. Kickplates: Ives 8400, or approved equal.
  - a. 1 ½ inches less than door width, 8" height typical unless door style prevents full height.
  - b. Material to match door hardware- .050 inch thickness typical, bevel top and two sides.
  - c. Fasteners: Manufacturer's standard exposed flush machine or self-tapping stainless steel screws.

I. PUSH-PULL TRIM

- i. Push plate: Ives 8200, 4" x 16" stainless steel, US32D or approved equal.
- ii. Pull trim, 1" round: Ives 8303, 4" x 16" plate, 10" centers, stainless steel, US32, Type F concealed mount with push plate for wood doors.
- iii. Pull trim, 1" round: Ives 8103EZ (ADA), with 4" x 16" plate 10" centers, stainless steel, US32, Type H-I-L concealed pull mounting for hollow metal door and solid-core wood door.

J. STOPS AND HOLDERS

- i. Wall Stops: Typical, provide blocking at each location.
- ii. Floor Stops: For locations where wall stops are impractical. Do not mount where door stops will impede traffic.
- iii. Silencers for Metal Door Frames: BHMA Grade 1, neoprene or rubber, min. ½" diameter, fabricated for drilled-in application of frame.
- iv. Hold Open: Flip-down stop attached to door, satin chrome finish.

K. OCCUPANCY INDICATOR LATCHES

- i. For Water Closet Doors to Display "OCCUPIED/VACANT"
- ii. Finish: US26D, 626 Satin Chrome

L. DOOR GASKETING

- i. Interior Doors for sound barrier: Provide continuous acoustic-strip seal at perimeter with bulb-type sweep at bottom.

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- ii. Exterior Doors: Provide continuous weather-strip gasketing at perimeter, meeting stile, and door bottoms.
    - a. Air leakage not to exceed 0.5 cfm per foot of crack length.
- M. SMOKE SEALS
- i. Head/Latch/Jamb – NGP 2525B or equal to accommodate double doors.  
<https://www.ngp.com/product-detail/?productId=556&catId=2&subcategory1Id=169>
  - ii. Sweep – NGP 200 SSS / Or finish to match existing door hardware.  
<https://www.ngp.com/product-detail/?productId=463&catId=2&subcategory1Id=186>
- N. THRESHOLDS
- i. All thresholds to meet ADA accessibility requirements.
  - ii. Exterior Threshold: Thermally broken aluminum.
  - iii. Dimension: Coordinate with door and wall thickness.
  - iv. Interior Thresholds: aluminum.
- O. WEATHER-STRIPPING
- i. Provide factory-installed weatherstripping in pre-hung Fiberglass or Aluminum storefront doors.
- P. SECURITY KEYPAD AND DOOR CONTACTS
- i. Coordinate components at locations noted on door schedule with Owner's Security Consultant for all materials to be provided by Owner's Security Consultant.
4. EXECUTION & QUALITY CONTROL  
Install according to manufacturer's written instructions unless specifically noted otherwise.
- A. GENERAL
- i. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
    - a. Standard Steel Doors and Frames: ANSI/SDI A250.8
    - b. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
  - ii. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
  - iii. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. LOCK CYLINDERS - **PLACEHOLDER – WAITING FOR KUA ALLEGION REP INFO.**
- i. Install construction cores to secure building and areas during construction period.
  - ii. Replace construction cores with permanent cores as directed by Owner or furnish permanent cores to Owner for installation.
- C. ADJUSTMENT

**KUA Kilton/Welch Dormitories & Faculty Residences**

Vermont Integrated Architecture, P.C.

*Revised April 12, 2023*, March 27, 2023 – Bid Package 1

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- i. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
  - ii. For entrance doors accessible to people with disabilities, adjust closers to provide a 5-second closer sweep period for doors to move from a 90-degree open position to 3 inches from the latch, measured to the leading door edge.
  - iii. Provide occupancy adjustment 3 months after date of Substantial Completion.
- D. CLEANING AND PROTECTION
- i. Clean adjacent surfaces soiled by door hardware installation and clean operating items as necessary to restore proper function and finish.
  - ii. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

END SECTION 087100 KUA DOOR HARDWARE

**088000 KUA GLAZING**

1. SUMMARY

This section identifies the glazing for glazing for interior windows and doors, interior fire-rated glazing systems, and wood and hollow metal door and frame systems. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

- 072500 Envelope Control Layers
- 079200 Joint Sealants
- 081100 Wood Doors and Frames
- 081113 Hollow Metal Doors and Frames
- 081416 Flush Wood Doors
- 081600 Exterior Doors and Frames
- 084000 Aluminum-Framed Entrances Storefronts and Curtain Wall
- 085200 Windows
- 087100 Door Hardware

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Plans, elevations, sections, details, attachment hardware
Product Cut Sheets	X	- For each listed material - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	- 6" x 6" sample of each listed product
Mock-ups	X	- As part of window mock-up - On-structure mock-up is acceptable. Testing of this mock-ups per Sections 019119 Exterior Envelope Commissioning and 014517 Field Testing of Exterior Assemblies to be coordinated with Envl. Cx. agent and Architect.
Closeout submittals	X	- Manufacturer's warranty Information, O & M Information

3. PRODUCTS

A. GLAZING AT EXTERIOR WINDOWS AND ENTRY DOORS

- i. Manufacturer: Cardinal, Guardian, OAE
- ii. BOD Product: Marvin + Cardinal 366/180, 2 Low E coatings, 1" insulating unit with airspaces, three panes glass, gas filled, warm edge spacer.
- iii. Spacer bar color: black, gray, or to match frame, selected by architect from manufacturer's standard offerings.
- iv. Performance (below assumes argon fill as BOD):
  - a. U: 0.2 max
  - b. SHGC: 0.21 max (E and W orientations), SHGC: 0.35 min. (S orientation)
  - c. VT: 0.47 min
  - d. CR: 65 min

- e. Energy Star rated
        - v. Sizes and locations: per schedule
  
  - B. GLAZING AT INTERIOR VESTIBULE AND INTERIOR ENTRY DOORS
    - i. Manufacturer: Cardinal, Guardian, OAE
    - ii. BOD Product: Cardinal ¾" dual-pane with air-space, insulated glass unit, Low-e 180 with argon fill, warm edge spacer.
    - iii. Spacer bar color: black, gray, or to match frame, selected by architect from manufacturer's standard offerings.
    - iv. Performance:
      - a. U: 0.3 max
      - b. SHGC: 0.55 max
      - c. VT: 0.60 min
      - d. CR: 50 min
    - v. Sizes and locations: per schedule
  
  - C. FIRE RESISTANCE RATED GLAZING- VISION LITES
    - i. Manufacturer: Safti First, Pilkington or approved equal.
    - ii. Product: FireLite NT/SuperLite XL-60: 3/4" thick, 45 or 60-minute fire-rated non-wired clear glazing, with impact, hose stream and 450 deg. F temperature rise limitation.
    - iii. Vision lite kit size: 6"x27"
    - iv. Labeling: Provide fire-rated glazing labeling.
    - v. Locations: 100 sq in. vision panel at doors as indicated in the Drawings.
  
  - D. GLAZING AT INTERIOR WOOD OR HOLLOW METAL FRAMES AND DOORS
    - i. Standard Glass: ¼" clear float glass.
      - a. At wall glazing above 18" AFF, at least 24" from doors.
    - ii. Tempered Glass: ¼" clear Kind FT heat-treated float glass.
      - a. At wall glazing at atrium enclosure.
      - b. At all non-rated interior door glazing and wall glazing below 18" AFF, within 24" of doors.
  
  - E. GLAZING SEALANTS AND TAPES
    - i. As required and provided by glazing supplier.
4. EXECUTION & QUALITY CONTROL  
Install according to manufacturer's written instructions unless specifically noted otherwise.
- A. PREPARATION
    - i. Field measurement: Verify actual dimensions of openings before fabrication and indicate field measurements on shop drawings.
  
  - B. INSTALLATION

- i. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
  - ii. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
  - iii. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- C. TESTING
- i. Install to be tested by Envelope Commissioning Agent. See Section 014517 FMP Field Testing of Exterior Assemblies, Section 072500 Envelope Control Layers and Code review for requirements.
- D. CLEANING
- i. Clean aluminum surfaces and glass immediately after installation. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

END SECTION 088000 KUA GLAZING

**092900 KUA GYPSUM BOARD**

1. SUMMARY

This section identifies the interior gypsum board to be used for wall finish and ceiling finishes in the interior of the building, as well as in rated assemblies. The gypsum board shall be installed on studs or channel, taped, and finished with paint or other finishes. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

- 061000 Rough Carpentry
- 078400 Fire-Resistive Joint Systems and Penetration Firestopping
- 079100 Movement Joints and Sealants
- 079200 Joint Sealants
- 099123 Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	-
Product Cut Sheets	X	- for each listed material - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
EPDs/HPDs	X	- for each listed material
Product Samples	X	- Expansion joint, tear-away bead, j-bead, corner bead
Mock-ups	X	- Reveal to trim, column, panel
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

A. GYPSUM BOARD – GENERAL

i. Comply with the following:

a. Content:

1. Made in the USA (to respond to toxicity concerns) and
2. with post-consumer recycled content. Provide % recycled content make-up information in submittal.

b. IAQ: Greenguard Gold certified

c. BOD Product: EcoSmart, OAE

<https://www.usg.com/content/usgcom/en/products/walls/drywall/drywall-panels/sustainable-panels.html#search-results>

d. Applicable Standards:

1. Comply with ASTM C1396 for ½” or 5/8 in. (15.9 mm), Type X, water-resistant gypsum wallboard, as appropriate.
2. Classified as a Class A Interior Finish Material per Section 803.1 of the International Building Code® (IBC®)
3. UL Classification as to fire resistance, surface-burning characteristics and noncombustibility.
4. Meet Architecture 2030 Challenge Criteria for Products



5. Living Building Challenge™ Red List Free
6. USDA Certified Biobased Product
7. Achieved GREENGUARD Gold Certification and qualifies as a low VOC emitting material (meets CA 01350)

B. INTERIOR TYPE "X" GYPSUM BOARD

- i. Manufacturer: USG, Certainteed, American Gypsum, Georgia Pacific or approved equal.
- ii. Product: Type "X" fire-rated gypsum wall board with 100% recycled paper faces.
- iii. Dimension: 5/8"x 4'x 8-12' sheet
- iv. Locations: At rated assemblies and as indicated on drawings

C. INTERIOR TYPE "C" GYPSUM BOARD

- i. Manufacturer: USG, Certainteed, American Gypsum, Georgia Pacific or approved equal.
- ii. Product: Type "C" fire-rated gypsum wall board with 100% recycled paper faces.
- iii. Dimension: 5/8"x 4'x 8-12' sheet
- iv. Locations: At rated assemblies and as indicated on drawings

D. MOISTURE AND MOLD-RESISTANT GYPSUM BOARD

- i. Manufacturer: USG, Certainteed, American Gypsum, Georgia Pacific or approved equal.
- ii. Product: Moisture and mold-resistant core and paper surface gypsum wall board with 100% recycled paper faces.
- iii. Dimension: 5/8"x 4'x8' sheet.
- iv. Locations: All toilet rooms, all janitor's closets, kitchen, and wet locations, and as indicated on drawings

E. INTERIOR TRIM ACCESSORIES

- i. Product: Galvanized or vinyl shapes.
  - a. Cornerbead – all cornerbead in circulation and high-traffic areas to be galvanized metal corner bead fastened with nails or screws at a minimum of 16" O.C.
  - b. Tear-away bead – Trim-Tex tear-away "L" Bead for flat transitions to adjacent materials.
  - 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. Trim-Tex Z-Shadow bead for overlapping layers of gypsum board.
  - g. Expansion (control) joint. Required every 30' for walls longer than 30'.
  - h. Curved-Edge Cornerbead: With notched or flexible flanges.
  - i. Termination Bead: to be provided at all locations where drywall meets any other material at wall or ceiling. (floor not needed)
- ii. Locations: at any location where gypsum board meets any other surface other than gypsum board a J-bead or termination bead is to be provided, typ.

F. JOINT TAPES

- i. Product: Paper tape allowed except at tile backer board locations.
- G. JOINT COMPOUND FOR INTERIOR GYPSUM BOARD
  - i. Product: All-purpose compound or as required.
- H. ACOUSTICAL AND FIRESTOP SEALANTS
  - i. Manufacturer: USG, Certainteed, or approved equal.
  - ii. Product: "Sheetrock" brand acoustical Sealant, Low VOC, for acoustic joint assemblies.
  - iii. Product: see section 078400 Fire-Resistive Joint Systems for Firestop Sealant products and locations.
- I. AUXILIARY MATERIALS
  - i. Products: Steel drill screws.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless indicated otherwise. Install control joints where indicated on the Drawings.

- A. INSTALLATION, GENERAL
  - i. All interior gypsum work shall meet applicable standards for workmanship regarding appearance and structural integrity.
  - ii. Level 4 finish unless otherwise indicated- for primer and finish application. See Section 099123 Interior Painting.
- B. PROTECTION OF WORK
  - i. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
  - ii. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
  - iii. Reject, remove and replace panels that are wet, moisture, or mold damaged.
- C. AT TILE BACKER
  - i. Fill joints between boards with latex-modified mortar and embed with fiberglass mesh joint tape.

END SECTION 092900 KUA GYPSUM BOARD

**093000 KUA CERAMIC TILE**

1. SUMMARY

This section identifies the ceramic tile flooring at the entry vestibules and the ceramic tile flooring, wall base and wall tile in the restrooms (including shower stalls) of the building. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections

- 018100 Sustainable Design Requirements
- 092900 Gypsum Board and Plaster
- 096500 Resilient Flooring
- 096513 Resilient Base and Accessories

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Tile layout and details for installation
Product Cut Sheets	X	- Each type of tile and other materials listed
Product Samples	X	Each tile and grout listed
Mock-ups	NA	
Closeout submittals	X	Warranty Information
	X	Operations and Maintenance Information

3. PRODUCTS

A. PAVER TILE- Vestibules, Entry Lobbies, Dorm Kitchens

- i. Manufacturer: Daltile or approved equal.
- ii. Product: "Haute Monde" porcelain tile.
  - a. Color: 12 x12, 12 x 24, 24 x 24
  - b. 5/16" thickness.
  - c. Cove Base: 6" x 12" color to match field tile.
- iii. Setting Material: latex modified thin-set on concrete direct set.
- iv. Grout: 3/16" grout joint w/ epoxy sanded grout.

B. MOSAIC TILE- BATHROOM FLOORS

- i. Manufacturer: American Olean, Daltile or approved equal.
- ii. Product: Unglazed ceramic mosaic porcelain tile dot-mounted on 12"x24".
  - a. Color 1: 1" Hexagon, Group 2 color: Ice White.
  - b. Color 2: 2 x 2 x 5/16" thickness field tile.
  - c. Bullnose: Built-up base MT5 - bullnose, 1x1, cove, 6" height (where no wall tile)
- iii. Setting Material: Latex modified thin-set on concrete.
- iv. Grout: Epoxy sanded grout for tile dot-mounted on 12"x24" panels.

C. GLAZED WALL TILE- BATHROOMS & KITCHEN BACKSPLASHES

- i. Manufacturer: Daltile, American Olean or approved equal.
- ii. Product: Glazed wall tile- matte and gloss "subway" tile in brick pattern.
  - a. Color 1: 3" x 6" x 5/16" thick, gloss subway tile, color groups 1 or 2.
  - b. Color 2: 3" x 6" x 5/16" thick, matte subway tile, color groups 1 or 2.
  - c. Cove base and bullnose: 3"x6" color groups 1 or 2.
- iii. Setting Material: Latex modified thin-set on tile backer board.
- iv. Grout: 1/16" grout joint w/ un-sanded epoxy grout.
- v. Location: First, second, and third floor bathrooms to ceiling, including shower stalls, kitchen (see drawings for heights).

D. WATERPROOFING MEMBRANE- AT ALL TOILET ROOM FLOORS TILED WALLS.

- i. Manufacturer: Laticrete International Inc. or approved equal.
- ii. Product: Laticrete Hydro Ban single component self-curing liquid rubber polymer waterproofing membrane, Greenguard Certified.

E. SEALANT/CAULK (JOINTS AND CORNERS)

- i. Manufacturer: As chosen by Subcontractor.
- ii. Product: Low VOC materials, as needed for a complete installation.

F. ACCESSORY MATERIALS

- i. Marble threshold at bathroom doors where no existing marble threshold.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. PREPARATION

- i. Substrates to be free of coatings, sealers or hardeners.
- ii. Protect existing marble tile floors and clean edges of existing marble tile where floor will meet new floor or wall tile.

B. INSTALLATION

- i. Install only after concrete and other substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours, have cured, and are dry to bond with adhesive as determined by manufacturer's recommended test. Install after painting and ceiling operations have been completed.
- ii. Waterproof concrete under toilet room tile according to manufacturer's written instructions.
- iii. Comply with manufacturer's written instructions for cleaning and protection after installation.

C. pROTECTION

- i. Cover until Substantial Completion.

END SECTION 093000 KUA CERAMIC TILE

**096400 KUA HARDWOOD FLOORING**

1. SUMMARY

This section identifies the hardwood flooring repair and refinishing or replacement at the new and existing faculty residences. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

- 018110 Sustainable Design Requirements
- 061000 Rough Carpentry
- 064023 Interior Architectural Woodwork

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	
Product Cut Sheets	X	For each listed product
Product Samples	X	Samples of wood species, prefinished wood
Mock-ups	NA	
Closeout submittals	X	Warranty Information, O&M Information

3. PRODUCTS

A. FLOORING ASSEMBLIES –

- i. See Detail FN2- AK 0.5/AW-0.5 for floor assembly @ new hardwood floor on slab on grade.
- ii. See Detail FC-2- AK 0.5/AW-0.5 for floor assembly @ new hardwood floor on slab on framed floor.

B. HARDWOOD FLOORING

- i. Solid Maple Hardwood Flooring
  - a. Species: Acer Sacharum
  - b. Grade: No. 1C
  - c. Dimension:
    - 1. Match width of existing strip flooring as necessary in existing buildings.
    - 2. For new construction strips 3 ¼” wide.
    - 3. Mixed length, min. 4’ long.
  - d. Edge: Tongue and Groove with square edge.

C. FLOOR FINISHING MATERIALS

- i. At existing floors with solid existing finish:
  - a. Field-Applied finish: 1 coat sealer, 1 coat satin finish
    - 1. Vermont Natural Coatings PolyWhey 3000 Sealer and Industrial Series 3500 Wood Floor Finish, Hillyard Basecoat and 1907 Gym Finish Sealer or approved equal. VOC < 200 g/L.

- ii. At new hardwood floors and existing floors needing full refinishing:
  - a. Field-Applied finish: 1 coat sealer, 3 coats satin finish
    - 1. Vermont Natural Coatings PolyWhey 3000 Sealer and Industrial Series 3500 Wood Floor Finish, Hillyard Basecoat and 1907 Gym Finish Sealer or approved equal. VOC < 200 g/L.

**D. MAINTENANCE MATERIALS**

- i. Hardwood Flooring: Furnish full-size units equal to 5 percent of amount installed for each type indicated (including finishes), from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- ii. Finishing Materials: Furnish extra materials (not less than one half gallon) from the same product run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

**4. EXECUTION & QUALITY CONTROL**

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

**A. PREPARATION**

- i. Examine existing floors and determine if replacement, repair, or full refinishing is necessary.
- ii. Prepare substrates to be free of coatings, sealers, hardeners, dirt and debris.

**B. INSTALLATION**

- i. Install after painting and ceiling operations have been completed.
- ii. Install rosin paper over substrate in larger areas, in accordance with manufacturer's instructions and at locations indicated on drawings. Overlap each piece of paper min. 2 ½" inches.
- iii. Install wood flooring in accordance to manufacturer's instructions and at locations indicate on drawings.
- iv. Fully blend new strip flooring with existing where walls have been removed or repair is necessary. Replace with minimum 2' long pieces.

**C. FINISHING**

- i. Machine-sand new flooring to remove all offsets and marks that would be noticeable after finishing. Vacuum and tack with a clean cloth immediately before applying finish.
- ii. Lightly sand existing flooring to prepare surface for new sealer and finish.
- iii. Apply floor finish in accordance to manufacturer's instructions.
- iv. Provide protection for floor finish until substantial completion.

END SECTION 096400 KUA HARDWOOD FLOORING

**096500 KUA RESILIENT FLOORING BASE AND ACCESSORIES**

1. SUMMARY

This section identifies the resilient flooring, rubber flooring for stairs, linoleum, resilient base and accessories to be used for flooring and wall base. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

- 033000 Cast-In-Place Concrete
- 061000 Rough Carpentry (Architectural)
- 061010 Rough Carpentry (Structural)
- 064023 Interior Architectural Woodwork
- 092900 Gypsum Board
- 096500 Resilient Flooring
- 096800 Carpeting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	- Installation patterns and proposed seaming, as required
Product Cut Sheets	X	- For all listed products. - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	- For all listed products.
Mock-ups	NA	
Closeout submittals	X	- Warranty Information, Operations & Maintenance Information.

3. PRODUCTS

A. GENERAL REQUIREMENTS:

- i. Life Safety: Per NFPA 101 Section 12.3.3.5.2, floor finishes in exit enclosures and exit access corridors and in spaces not separated from them by walls complying with 12.3.6 and shall not be less than Class II
  - a. Per NFPA 101 Section 10.2.7.4.2 Class II interior floor finish shall have a critical radiant flux of not less than 0.22 W/cm<sup>2</sup> but less than 0.45 W/cm<sup>2</sup>
  - b. Per NFPA 101 Section 10.2.7.5 Wherever the use of Class II interior floor finish is required, Class I interior floor finish shall be permitted.
- ii. Sustainability and Health:
  - a. GREENGUARD Gold Certified for Low VOC Emissions
    - 1. Adhesives: VOC content of 40 g/L or less.
  - b. Supply all required products that are CA 01350 compliant.
  - c. ISO 14001 Environmental Management Systems certification.
  - d. Construction waste take back program for the purpose of reducing jobsite waste by taking back uninstalled waste flooring.
  - e. Flooring surfaces that are easily cleaned and do not require coatings and stripping, or use chemicals that may be hazardous to human health.



- f. Flooring that is free of materials known to be teratogenic, mutagenic or carcinogenic.
      - g. Flooring that contains no polyvinyl chloride or plasticizers, halogens, phlates, nor asbestos.
    - iii. Installation: appropriate backer, substrate prep and underlayment shall be provided to meet manufacturer's recommendations for each of the materials described below and in the areas indicated on the finish floor plan.
    - iv. Substrate inspection and surface prep: to be per manufacturer's instructions and is the responsibility of the contractor to review and confirm as a part of project scope.
    - v. Underlayment: Provide required underlayment, per manufacturer's instructions and for the appropriate substrate material and condition.
- B. RESILIENT MATERIALS – GENERAL REQUIREMENTS:
  - i. Applicable Standards: ASTM F1344
  - ii. Sustainability and Health:
    - a. GREENGUARD Gold Certified for Low VOC Emissions
      - 1. Adhesives: VOC content of 40 g/L or less.
    - b. Supply all required products that are CA 01350 compliant.
    - c. ISO 14001 Environmental Management Systems certification.
    - d. Construction waste take back program for the purpose of reducing jobsite waste by taking back uninstalled waste flooring.
    - e. Flooring surfaces that are easily cleaned and do not require coatings and stripping, or use chemicals that may be hazardous to human health.
    - f. Flooring that is free of materials known to be teratogenic, mutagenic or carcinogenic.
    - g. Flooring that contains no polyvinyl chloride or plasticizers, halogens, nor asbestos.
  - iii. Installation: appropriate backer, substrate prep and underlayment shall be provided to meet manufacturer's recommendations for each of the materials described below and in the areas indicated on the finish floor plan.
  - iv. Substrate inspection and surface prep: to be per manufacturer's instructions and is the responsibility of the contractor to review and confirm as a part of project scope.
  - v. Underlayment: Provide required underlayment, per manufacturer's instructions and for the appropriate substrate material and condition.
- C. LINOLEUM RESILIENT SHEET FLOORING
  - i. Manufacturer: Forbo Marmoleum or approved equal.
  - ii. BOD Product: Commercial Linoleum
  - iii. Dimension: Standard width, 0.1" minimum thickness, coils in manufacturer's standard length.
  - iv. Seams: Heat welded w/ manufacturer's standard color-matched solid color welding rod.
  - v. Collection: Vivace
  - vi. Colors: As chosen by architect from the full range of product colors.
  - vii. Locations: as indicated on finish plans and schedules (Note that the numerical modifier allows for the potential of a different color selection by the Architect and Owner with no other change to the specified product.)

D. RESILIENT FLOORING – VULCANIZED RUBBER

- i. Manufacturer: Nora Rubber Flooring, Johnsonite, Burke Flooring, Endura Rubber Flooring, Felxco Inc., Roppe Corp. or approved equal.
- ii. Product: Type TS (vulcanized thermoset rubber), (ASTM D 1566 and ASTM D 883.)
  - a. Basis of Design: Nora vulcanized rubber vulcanized rubber compound 925 with environmentally compatible color pigments that are free of toxic heavy metals like lead, cadmium or mercury
  - b. Treads, risers, stringers, landings, and base.
  - c. ASTM F1344: Type IA, Grade 1
  - d. Composition: Homogeneous
  - e. Surface/Pattern: Round for treads and landings.
  - f. Back of Tile: Double-sanded smooth
  - g. Performance:
    - 1. Hardness (ASTM D2240):– not less than 85, Shore type “A”
    - 2. Static Load Limit (ASTM F970) :- Residual indentation not greater than 0.005 inches at 250 psi
    - 3. Abrasion Resistance (ASTM D3389): - weight loss not to exceed 1 gram
    - 4. Dimensional Stability - shall not exceed 0.15% in both directions
    - 5. Flammability (E648/NFPA 253):  $\geq 0.45$  watts/sq. cm for Class 1 is required
    - 6. Smoke Density (ASTM E662/NFPA 258):  $< 450$  is required
    - 7. Slip Resistance (ASTM D2047):  $\geq 0.5$  is required
    - 8. VOCs: GREENGUARD Gold Certified for Low VOC Emissions and CA 01350 compliant
    - 9. Latex Allergies (ASTM D6499)
    - 10. Sound Absorption (ISO 140):  $\Delta$  Lw 12 dB (compare only  $\Delta$  values)
  - h. Dimensions and Permissible Variations
    - 1. Thickness (ASTM F386): 0.080 inches minimum
      - a. Thickness Tolerances (as specified) - Smooth surface tile + 0.005 inches
      - b. Molded pattern tile + 0.015 / - 0.005 inches
      - c. Embossed pattern tile + 0.015 / - 0.005 inches
    - 2. Squareness (ASTM F2055): - Not out more than 0.010 inches
    - 3. Quality of Cut (Joint Tightness) - not more than 0.005 inches
- iii. Limited Wear Warranty: 10 years
- iv. Locations: for stairs and landings as indicated on finish plans and schedules (Note that the numerical modifier allows for the potential of a different color selection by the Architect and Owner with no other change to the specified product.)

E. RESILIENT BASE – VULCANIZED RUBBER BASE

- i. Manufacturer: Nora Rubber Flooring, Johnsonite, Burke Flooring, Endura Rubber Flooring, Felxco Inc., Roppe Corp. or approved equal
- ii. Product: Type TS (Vulcanized Thermoset Rubber), Group 1, (solid, homogeneous), cove
- iii. Include stringer base for stairs to match.

- iv. Dimension: 4" height, 0.125" minimum thickness, coils in manufacturer's standard length.
  - v. Corners: Job formed.
  - vi. Finish: Satin finish, colors as selected by Architect from the full range of industry colors.
  - vii. Locations: as indicated on finish plans and schedules (Note that the numerical modifier allows for the potential of a different color selection by the Architect and Owner with no other change to the specified product.)
- F. MISCELLANEOUS FLOORING ACCESSORIES
- i. Manufacturer: Nora Rubber Flooring, Johnsonite, Burke Flooring, Endura Rubber Flooring, Felxco Inc., Roppe Corp. or approved equal.
  - ii. Product:
    - a. Carpet edge.
    - b. Nosing for resilient flooring.
    - c. Reducer strip for resilient flooring.
    - d. Joiner for tile and carpet.
    - e. Transition strips.
  - iii. Material/Colors: by Architect
  - iv. Locations: Provide as required at flooring material transitions as shown on finish plan and as recommended by flooring manufacturer.
- G. INSTALLATION MATERIALS
- i. Trowelable Leveling and patching compounds- Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
  - ii. Adhesives: Water-resistant, VOC content of 40 g/L or less.
  - iii. Stair-tread-nose filler: Two-part epoxy compound.
  - iv. Metal edge strips: Mill finish extruded aluminum.
  - v. Floor polish: As recommended by manufacturer.
- H. MAINTENANCE MATERIALS
- i. Resilient Flooring: Furnish sheet material or full-size units equal to 5 percent of amount installed for each type indicated, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. PREPARATION

- i. Prepare substrates to be free of coatings, sealers or hardeners. Fill cracks, holes and depressions w/ trowelable compound.
- ii. Per ASTM F710 (Concrete Substrate prep) and the Manufacturer's Installation Guide

- iii. Install primer/sealer only after concrete and other substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours, have cured, and are dry to bond with adhesive as determined by manufacturer's recommended test.
  - iv. Install sealer only after gypsum underlayment tests below 5% moisture content using a moisture meter with a gypsum scale.
  - v. Apply gypsum sealer/primer and allow to dry.
- B. INSTALLATION**
- i. Install only after concrete and other substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours, have cured, and are dry to bond with adhesive as determined by manufacturer's recommended test.
  - ii. Install after painting and ceiling operations have been completed.
  - iii. Comply with manufacturer's written instructions for installation using maximum lengths possible and inside and outside corners. Tightly adhere material to substrate throughout surface of each piece.
  - iv. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in floor covering substrates.
- C. CLEANING AND PROTECTION**
- i. Comply with manufacturer's written instructions for cleaning and protection after installation.
  - ii. Remove adhesives and other blemishes and soil from material before applying 2 coats liquid floor polish or as specified by manufacturer.
  - iii. Cover until Substantial Completion.

END SECTION 096500 KUA RESILIENT FLOORING BASE AND ACCESSORIES

**096500 KUA RESILIENT FLOORING**

1. SUMMARY

This section identifies the resilient flooring in the building. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

- 061000 Rough Carpentry
- 096513 Resilient Base and Accessories
- 096800 Carpeting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Detailed floor layouts , include seam locations.
Product Cut Sheets	X	- for each listed product
Product Samples	X	samples of each color and pattern for each listed product
Mock-ups	NA	
Closeout submittals	X	Warranty Information
	X	Maintenance manuals for each product.

3. PRODUCTS

A. RESILIENT SHEET FLOORING

- i. Manufacturer: Forbo Marmoleum or approved equal.
- ii. Product: Commercial Sheet Linoleum
- iii. Dimension: Standard width, 0.1" minimum thickness, coils in manufacturer's standard length.
- iv. Seams: Heat welded w/ manufacturer's standard color-matched solid color welding rod.
- v. Colors: As chosen by architect from the full range of premium product colors and patterns.

B. RESILIENT SHEET FLOORING - TILES

- i. Manufacturer: Forbo Marmoleum or approved equal.
- ii. Product: Commercial Linoleum
- iii. Dimension: Standard size tiles, 0.1" minimum thickness.
- iv. Seams: Butt jointed tiles.

- v. Color and Pattern: As chosen by architect from the full range of premium product colors and patterns.
- C. INSTALLATION MATERIALS
- i. Trowel-able Leveling and patching compounds- Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
  - ii. Adhesives: Water-resistant, VOC content of 60 g/L or less.
    - a. LVT: As recommended by manufacturer.
    - b. Sheet Vinyl: As recommended by manufacturer.
    - c. Forbo: Forbo Flooring, Inc., L 885 Adhesive.
  - iii. Floor polish: If and as recommended by each manufacturer.
- D. MAINTENANCE MATERIALS
- i. Resilient Flooring: Furnish sheet material or full-size units equal to 5 percent of amount installed for each type indicated, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
4. EXECUTION & QUALITY CONTROL
- Store and install according to manufacturer's written instructions unless specifically noted otherwise.
- A. PREPARATION
- i. Prepare substrates to be free of coatings, mud, oil, grease, and other contaminants. If applicable, fill cracks, holes and depressions w/ trowelable leveling compound.
  - ii. For concrete, install primer/sealer only after concrete and other substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours, have cured, and are dry to bond with adhesive as determined by manufacturer's recommended test. Apply gypsum sealer/primer and allow to dry.
  - iii. For wood substrates, ship and level with wood sheathing and luan as necessary to bring existing condition as level as possible. If installer believes application will not be level and flat, bring to the Architect's attention prior to installation.
- B. INSTALLATION
- i. Install after painting and ceiling operations have been completed.
  - ii. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in floor covering substrates.
- C. CLEANING AND PROTECTION
- i. Comply with manufacturer's written instructions for cleaning and protection after installation.

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- ii. Remove adhesives and other blemishes and soil from material before applying and finish as specified by manufacturer.
- iii. Cover until Substantial Completion.

END SECTION 096500 KUA RESILIENT FLOORING

**096800 KUA CARPETING**

1. SUMMARY

This section identifies the tile carpeting as shown on the finish plans and schedule. In addition, this section addresses the fabrication, fasteners, finishes and best practices for installation.

Related Sections:

- 033000 Cast-in-Place Concrete
- 061000 Rough Carpentry
- 096500 Resilient Flooring Base and Accessories

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	
Product Cut Sheets	X	- Documentation of CRI's "Green Label Plus" program, "Declare Label," and Red List free compliance and adhesive VOC content for each product.
EPDs/HPDs	X	- for each listed material
Product Samples	X	- Of each type of carpet tile (min 3 full tiles). NOTE: Since colors and pattern have not been finalized – samples for up to 6 options will be provided.
Mock-ups	NA	-
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

A. GENERAL REQUIREMENTS:

- i. Life Safety: Per NFPA 101 Section 12.3.3.5.2, floor finishes in exit enclosures and exit access corridors and in spaces not separated from them by walls complying with 12.3.6 and shall not be less than Class II
  - a. Per NFPA 101 Section 10.2.7.4.2 Class II interior floor finish shall have a critical radiant flux of not less than 0.22 W/cm<sup>2</sup> but less than 0.45 W/cm<sup>2</sup>
  - b. Per NFPA 101 Section 10.2.7.5 Wherever the use of Class II interior floor finish is required, Class I interior floor finish shall be permitted.
- ii. Sustainability and Health:
  - a. GREENGUARD Label Plus, Carbon Neutral Floor Certification
    - 1. Adhesives: VOC content of .5 mg/m<sup>3</sup> or less
  - b. "Declare Label" Certification
  - c. Products must be Red List free.
  - d. Supply all required products that are CA 01350 compliant.
  - e. ISO 14001 Environmental Management Systems certification.
  - f. Construction waste take back program for the purpose of reducing jobsite waste by taking back uninstalled waste flooring.
  - g. Flooring surfaces that are easily cleaned and do not require coatings and stripping, or use chemicals that may be hazardous to human health.



- h. Flooring that is free of materials known to be teratogenic, mutagenic or carcinogenic.
  - i. Flooring that contains no polyvinyl chloride or plasticizers, halogens, phlates, formaldehyde, heavy metals, fluorinated chemicals (PFAs), halogenated fire retardants, nor asbestos.
  - iii. Installation: appropriate backer, substrate prep and underlayment shall be provided to meet manufacturer's recommendations for each of the materials described below and in the areas indicated on the finish floor plan.
  - iv. Substrate inspection and surface prep: to be per manufacturer's instructions and is the responsibility of the contractor to review and confirm as a part of project scope.
  - v. Underlayment: Provide required underlayment, per manufacturer's instructions and for the appropriate substrate material and condition.
- B. CARPET TILE
- i. Manufacturer: Mohawk, Shaw, Milliken, Interface
  - ii. Basis of Design Product/Style: Mohawk Sabbatical or similar
  - iii. Construction: Level Heathered Loop
  - iv. Fiber: Post-Consumer Content Nylon
  - v. Dye Method: Solution Dyed 100%
  - vi. Tufted Weight: 20oz/yd<sup>2</sup>
  - vii. No preservatives.
  - viii. Gauge: 1/12
  - ix. Stitched: 13.8 per inch
  - x. Finished Pile Thickness: 0.4"
  - xi. Total Thickness: 0.249"
  - xii. Average Density: 7578 ozs/yd<sup>3</sup>
  - xiii. Product size: 12" x 36"
  - xiv. Pattern repeat: none
  - xv. Backing: Provide mildew resistant backing and carpet pad suitable for placement on wood sheathing. PVC-Free backing system.
    - a. Product: CQuest BioX
  - xvi. Protective Treatments: SSP Shaw Soil Protection, OAE
  - xvii. Color: from full range of manufacturer's colors
  - xviii. Seam Sealer: As required per the carpet manufacturer.
  - xix. Pad: Pad shall as required/recommended by product manufacturer for each substrate show in the drawings.
  - xx. Flooring Adhesive: Shaw Adhesive 5036 Antimicrobial or as recommended by manufacturer.
  - xxi. Testing:
    - a. Radiant Panel (ASTM E-648): Class I
    - b. Smoke Density (ASTM E-662): <450
    - c. Static Control (AATCC-134): <3.5kv
      - 1. Meet ADA guidelines for min. statis coefficient of friction of 0.6 for accessible routes
      - 2. Traffic Classification - Severe
    - d. Antimicrobial (AATCC-174): Passes (if installed with Shaw Adhesive 5036 Antimicrobial)
  - xxii. Certifications:

- a. Green Label Plus
  - b. NSF 140 Gold
  - c. Declare Label
  - d. Red List Free
  - e. Underlayment and Substrate preparation: Per manufacturer's recommendations.
  - f. Installation:
    - 1. Test substrate moisture content prior to install for compliance with manufacturer's requirement. Install per manufacturer's instructions over approved underlayment/substrates. Direct glue-down.
  - g. Installation pattern: Installation pattern to be confirmed with Architect, prior to commencement of work.
  - h. Locations: as shown on finish plan and schedule
    - 1. Student Lounges
    - 2. Full carpet schedule to be developed during the shop drawing process. Contractor should expect use of up to four (4) different products.
- xxiii. Warranty: 15 years.

C. **INSTALLATION ACCESSORIES**

- i. Trowelable Leveling and Patching Compound: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- ii. Adhesives: Water-resistant, VOC content of .5 mg/m<sup>3</sup> or less Pressure-sensitive type to suit products and subfloor conditions indicated, for releasable installation.
- iii. Metal Edge/Transition Strips: Schluter or approved equal; Extruded mill finish aluminum in profiles as required to neatly protect exposed carpet edges. Locate at all transitions from carpet to a different type of flooring, or to bare concrete slab.

4. **EXECUTION & QUALITY CONTROL**

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. **PREPARATION**

- i. Verify that sheathing and/or slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
- ii. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch.

B. **INSTALLATION**

- i. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- ii. Do not mix dye lots in same area.

- iii. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- C. CLEANING AND PROTECTION
- i. Remove excess adhesive, seam sealer, protruding yarns, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  - ii. Vacuum carpet tile using commercial machine with face-beater element.
  - iii. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.
- D. MAINTENANCE MATERIALS
- i. Carpet Tile: Furnish Full-size units equal to five (5) percent of amount installed for each type indicated, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

END SECTION 096800 KUA CARPETING

**099113 KUA EXTERIOR PAINTING AND STAINING**

1. SUMMARY

This section identifies the painting of the exterior materials, including exterior metals, columns, soffit, fascia, and trim. See drawings for locations and additional detail. Final color selections to be provided by Architect. In addition, this section addresses the best practices for installation.

Related Sections:

062013 Exterior Finish Carpentry

099123 Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	-
Product Cut Sheets	X	- For each type of primer, paint, and finish - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	- 30" square labeled sample on rigid backing for each color and gloss of topcoat, 4' length of fir for transparent finish
Mock-ups	NA	
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

A. PAINTS GENERAL

- i. Basis of Design Manufacturer: Benjamin Moore, Sherwin Williams or approved equal.
- ii. Zero - VOC Content: Comply with the following:
  - a. LEED v4, GREENGUARD/GREENSEAL compliant
    - 1. Flat Coating (Green Seal GS-11, 1993): VOC - 50 g/L max.
    - 2. Non-flat Coating (Green Seal GS-11, 1993): VOC - 150 g/L max.
    - 3. Anti-corrosive/Anti-rust Paint: VOC - 250 g/L max.
    - 4. Clear Wood Finish: Varnish: VOC - 350 g/L max.
    - 5. Primers, Sealer and Undercoats: VOC - 200 g/L max.
  - b. Colors: As selected by the Architect.

B. EXTERIOR PRIMER/SEALER FOR WOOD AND ENGINEERED WOOD

- i. Alkyd primer/sealer compatible with manufacturer's finish coat.

C. METAL PRIMER

- i. Touch-up Primer: PPG Multiprime, Modified alkyd resin primer or as provided by steel fabricator.

D. METAL FINISHES

- i. Basis of Design: Sherwin Williams, Polane S Plus Polyurethane Enamel, low gloss, two component, acrylic polyurethane. Spray applied. Match coating to primer.

E. EXTERIOR CLEAR FINISH FOR EXPOSED WOOD AND CLEAR FINISH PLYWOOD

- i. Basis of Design: Penofin Red Label, Sikkens ProLuxe Cetol SRD Translucent Wood finish, or approved equal as recommended by contractor. One coat penetrating oil finish for durability and ease of maintenance.
  - a. VOC limits: Less than 250 g/l.
  - b. Color: As chosen by architect from the full range of colors.
  - c. Provide second coat of finish after one year.

F. WATER-BASED PAINTS

- i. Basis of Design: Sherwin Williams
  - a. Latex Exterior Flat
  - b. Latex Exterior Semi-gloss (trim and fascias)
  - c. Latex Exterior Satin (field and soffits)

G. EXTERIOR PAINT FOR CEMENT BOARD SIDING

- i. Basis of Design: Sherwin Williams ‘Superpaint’ Exterior Acrylic Latex.
  - a. VOC limits: Less than 250 g/l.
  - b. Color: As chosen by architect from the full range of colors.
  - c. Cement Board Siding to be pre-finished. Touch up and paint all cuts and ends in field during installation.
  - d. Apply full finish coat in field once all exterior trim and siding is installed.

H. EXTERIOR PAINT FOR SOFFITS AND FASCIAS

- i. Basis of Design: Sherwin Williams ‘Superpaint’ Exterior Acrylic Latex.
  - a. VOC limits: Less than 250 g/l.
  - b. Color: As chosen by architect from the full range of colors.

I. EXTERIOR WOOD FILLER

- i. Product: Abatron LiquidWood and WoodEpoxy or approved equal.
  - a. 2-part penetrating wood consolidant, Greenguard Certified, zero VOC.
  - b. 2-part wood replacement putty, Greenguard Certified, zero VOC.

J. MAINTENANCE MATERIALS

- i. Product: Furnish extra materials from the same product run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - a. Paint: portions of paint partially used for project work.

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions and recommendations in “MPI” Manual unless specifically noted otherwise.

A. PREPARATION

- i. Examination of Substrates:
  - a. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
    - 1. Concrete: 12 percent.
    - 2. Wood: 15 percent.
  - ii. Clean substrates of substances that could impair bond of paints
  - iii. Fully scrape existing building as necessary. Contain and paint chippings that are loose and removed. Dispose of as required by the State of Vermont.
  
- B. APPLICATION
  - i. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
  - ii. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
  - iii. Provide one coat primer, two coats finish, typ.
  
- C. CLEANING AND PROTECTION
  - i. 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.
  - ii. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
  
- D. EXTERIOR PAINTING SCHEDULE
  - i. To be provided by Architect

END SECTION 099113 KUA EXTERIOR PAINTING AND STAINING

**099123 KUA INTERIOR PAINTING AND STAINING**

1. SUMMARY

This section identifies the interior painting, staining, and finishing for doors, frames, interior wood trim, window sills, walls, wall base, ceilings, and columns in the building. In addition, this section addresses the best practices for installation.

Related Sections:

- 055000 Metal Fabrications
- 062023 Interior Finish Carpentry
- 064023 Interior Architectural Woodwork
- 078400 Fire-Resistive Joint Systems and Penetration Firestopping
- 081113 Hollow Metal Doors and Frames
- 081416 Flush Wood Doors
- 092900 Gypsum Board
- 099113 Exterior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	-
Product Cut Sheets	X	- For each type of primer, paint and finish
EPDs/HPDs	X	- For each material
Product Samples	X	- 2' piece of wood for clear finish - 30" square labeled sample on rigid backing for each color and gloss of topcoat
Mock-ups		-
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

A. GENERAL REQUIREMENTS:

- i. Life Safety: Per NFPA 101 Section 12.3.3.5.2, floor finishes in exit enclosures and exit access corridors and in spaces not separated from them by walls complying with 12.3.6 and shall not be less than Class II
  - a. Per NFPA 101 Section 10.2.7.4.2 Class II interior floor finish shall have a critical radiant flux of not less than 0.22 W/cm<sup>2</sup> but less than 0.45 W/cm<sup>2</sup>
  - b. Per NFPA 101 Section 10.2.7.5 Wherever the use of Class II interior floor finish is required, Class I interior floor finish shall be permitted.

B. PAINTS GENERAL

- i. Manufacturer: Benjamin Moore, Sherwin Williams or approved equal.
- ii. Basis of Design Product: ProMar 400 or approved equal.
- iii. Zero - VOC Content: Comply with the following:

- 
- a. LEED v4, GREENGUARD/GREENSEAL compliant
    - 1. Flat Coating (Green Seal GS-11, 1993): VOC - 50 g/L max.
    - 2. Non-flat Coating (Green Seal GS-11, 1993): VOC - 150 g/L max.
    - 3. Anti-corrosive/Anti-rust Paint: VOC - 250 g/L max.
    - 4. Clear Wood Finish: Varnish: VOC - 350 g/L max.
    - 5. Primers, Sealer and Undercoats: VOC - 200 g/L max.
  - b. Colors: As selected by the Architect.
  - c. Assume the following number of colors throughout:
    - 1. Ceiling
    - 2. Field wall color
    - 3. Up to six (6) accent wall colors
- C. INTERIOR WATER-BASED PRIMER/SEALER
- i. Latex based interior: Zero-VOC Interior Latex Primer or approved equivalent (MPI #50 or Institutional Low Oder/VOC MPI #149)
- D. WATER-BASED PAINTS
- i. Latex Interior Eggshell, (Gloss Level 2): MPI #44
  - ii. Latex Interior Semi-gloss, (Gloss Level 5): MPI # 54
- E. METAL PAINTS (EXPOSED STRUCTURAL STEEL, EXPOSED DUCTWORK AND ACCESSORIES, DOOR FRAMES, HANDRAILS, GUARDRAILS, STAIR AND BALLUSTER SYSTEMS)
- i. Latex Interior Semi-gloss, (Gloss Level 5): MPI # 54
    - a. For spray application.
- F. STAINS AND TRANSPARENT FINISHES FOR WOOD
- i. Manufacturer: Vermont Natural Coatings, Sherwin Williams, Minwax, Cabot or as chosen by Subcontractor to meet criteria below unless Manufacturer is specified.
  - ii. VOC Content: Comply with the following:
  - iii. Clear Wood Finishes: non-yellowing, Polyurethane
  - iv. VOC not more than 200 g/L.
  - v. Note: confirm compatibility with CLT and Glu-lam adhesives for all exposed architectural finish locations. See structural specifications for additional information regarding sealants and finishes for CLT and Glu-lam elements.
- G. INTUMESCENT FIRE BARRIER PAINT
- i. Manufacturer: FlameOFF, OAE
  - ii. Basis of Design Product: FlameOFF Fire Barrier Paint, OAE
  - iii. Material: water based, thin film intumescent coating
  - iv. Rating: min 1-hr over wood
    - a. Tests/Certifications:
      - 1. E119/UL 263
      - 2. ICC ES Listed
      - 3. UL Classified
  - v. Flame spread and smoke development: Class A
    - a. Tests/Certifications:
      - 1. E84/UL 723



- 2. ICC ES Listed
  - 3. UL Classified
  - vi. VOC Content: not more than 50 g/L.
  - vii. Surface prep and installation: per manufacturer's requirements.
  - viii. Locations: at CLT recess in 1-hr rated floor/ceiling, and where indicated on drawings
- H. WOOD STAIR TREAD FINISH
- i. Product: slip resistance floor finish, see above for general requirements
  - ii. Non-yellowing, Water-based urethane- Satin.
  - iii. VOC not more than 250 g/L
- I. WOOD FILLER GENERAL
- i. Manufacturer: Sherwin Williams, Minwax, Cabot or as chosen by Subcontractor to meet criteria below unless Manufacturer is specified.
  - ii. Greenguard Certified, zero VOC.
- J. CAULK/SEALANT
- i. Non-VOC Caulks and Sealants as required for the work.
- K. MAINTENANCE MATERIALS
- i. Product: Furnish extra materials from the same product run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    - a. Paint: 5 percent, but not less than 1 gal. of each material and color applied.
4. EXECUTION & QUALITY CONTROL
- Store and install according to manufacturer's written instructions and recommendations in "MPI" Manual unless specifically noted otherwise.
- A. PREPARATION
- i. Examination of Substrates:
    - a. All substrates shall be clean and dry prior to application.
    - b. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
      - 1. Concrete: 12 percent.
      - 2. Wood: 15 percent.
      - 3. Gypsum Board: 12 percent.
      - 4. Plaster: 12 percent.
    - c. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
    - d. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
  - ii. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting. Reinstall items that were removed.

- iii. Existing concrete walls, ceilings and metal roof deck
  - a. Pressure wash to remove dirt, efflorescence and loose paint.
- iv. Existing steel joists at Storage Building
  - a. Sand-blast to remove rust, efflorescence from concrete and dirt.
- v. Existing steel columns at Storage Building
  - a. Pressure wash to remove loose paint. Wire brush to remove surface rust.
  
- B. APPLICATION
  - i. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
  - ii. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
  
- C. CLEANING AND PROTECTION
  - i. 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.
  - ii. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
  
- D. INTERIOR PAINTING AND STAINING SCHEDULE
  - i. Primed Steel Substrates: Door Frames, Handrails
    - a. Latex over Shop Primer System
      - 1. Touchup of Shop Primer; Intermediate Coat, semi-gloss, (Gloss Level 5); Topcoat, semi-gloss, (Gloss Level 5).
  - ii. Exposed Structural Steel columns
    - a. Latex over existing paint.
      - 1. Reapply Primer; Intermediate Coat, semi-gloss, (Gloss Level 5); Topcoat, semi-gloss, (Gloss Level 5).
  - iii. Gypsum Substrates:
    - a. Two finish coats over primer
      - 1. Finish Coats: SW ProGreen Low Odor Interior Latex, (4 mils wet, 1.4 mils dry per coat)
        - a. Gypsum Board Ceilings: Flat
        - b. Gypsum Board Walls (excluding toilet room): Eggshell (Gloss Level 2)
        - c. Gypsum Board Walls in Toilet Room: Satin
  - iv. Wood Substrates, nontraffic:
    - a. Window Sills and Wall Cap:
      - 1. Clear finish on hardwood.

END SECTION 099123 KUA INTERIOR PAINTING AND STAINING

**101400 KUA SIGNAGE**

1. SUMMARY

This section identifies signage at the interior of the building only. In addition, this section addresses the best practices for installation.

Related Sections:

099123 Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- For each sign or typical sign including graphics and text, braille, etc.
Product Cut Sheets	X	- For each type of sign and/or sign material. - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	- One letter or sample room sign for each type of sign. - Color swatches for background and text colors
Mock-ups		-
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

A. GENERAL REQUIREMENTS:

- i. All signage to meet ADA guidelines for text sizing, mounting/installation, and graphics.
  - a. Consult ADAAG Section 4.30 for additional information.
    - 1. Character Proportion: Letters and numbers on signs shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10
  - b. See ADA section 703 for all the text, character, font type, size, mounting, braille, etc. requirements
- ii. Any questions, conflicts, or discrepancies to be brought to the attention of the architect prior to the commencement of work.

B. SINGLE-OCCUPANCY ACCESSIBLE WATER CLOSET SIGNAGE

- i. ADA Compliant Signage
  - a. Material: Recycled Plastic
  - b. Size: as required
  - c. Text and Graphics:
    - 1. 1" lettering w/ Braille at base (must meet ADA requirements)
    - 2. Confirm graphics with architect prior to ordering and to comply with applicable state law. Binary gender icons are not be permitted. (i.e. "Restroom" and Wheelchair icon only)

- d. Locations: See drawings, one per each WC room.
  - e. Background color and text color: By Architect and with contrast to meet ADA.
- C. INTERIOR ROOM SIGNAGE (ALL OTHER ROOMS)
- i. ADA Compliant Signage
    - a. Material: Recycled Plastic
    - b. Size: assume 8" w x 4" h for pricing, final text and sizes to be confirmed by submittal
    - c. Text and Graphics:
      - 1. 1" lettering w/ Braille at base (must meet ADA requirements)
      - 2. Service, Support and support rooms may require the "No storage permitted" to be included on sign. Confirm with Architect.
    - d. Locations: (to be provided at new or renovated spaces only)
      - 1. One at each interior room with a door including stairs and vestibules.
      - 2. One at each "area of refuge" noted on plans
    - e. Background color and text color: By Architect and with contrast to meet ADA.
- D. STAIR SIGNAGE (to be provided at new or renovated spaces only)
- i. ADA Compliant Signage
    - a. Material: Recycled Plastic
    - b. Size: as required
    - c. Text and Graphics:
      - 1. 1" lettering w/ Braille at base (must meet ADA/ABA requirements)
      - 2. To meet requirements of 7.2.2.5.4 of NFPA 101
      - 3. "NO ROOF ACCESS" shall designate stairways that do not provide roof access.
    - d. Locations:
      - 1. One at each floor level landing inside the stair
      - 2. Tactile signs at each exit door to stair
    - e. Background color and text color: By Architect and with contrast to meet ADA.
- E. ACCESSIBLE PARKING SIGNAGE
- i. ADA Compliant Signage as per Civil drawings (Accessible reserved parking sign (R7-8) and van accessible (R7-8a) (12"x18"))
    - a. ADAAG 4.6.4 - Accessible parking spaces shall be designated as reserved by a sign showing the symbol of accessibility (see 4.30.7). Spaces complying with 4.1.2(5)(b) shall have an additional sign "Van-Accessible" mounted below the symbol of accessibility. Such signs shall be located so they cannot be obscured by a vehicle parked in the space.
    - b. Material: Painted Metal
    - c. Size: as required
    - d. Installation/Mounting: Post mounted, see civil drawings
    - e. Locations:
      - 1. See civil drawings
    - f. Background color and text color: By Architect and with contrast to meet ADA.
- F. ELEVATOR HOISTWAY SIGNAGE

- a. Signs at elevator hoistways shall comply with ADA Section 407.2.3
  1. 407.2.3.1 Floor Designation: Floor designations complying with 703.2 and 703.4 shall be provided on both jambs of elevator hoistway entrances.
  2. Provide both tactile characters (2" min height) and braille.
  3. Provide tactile star on both jambs at main entry level. (see example from ADA below)

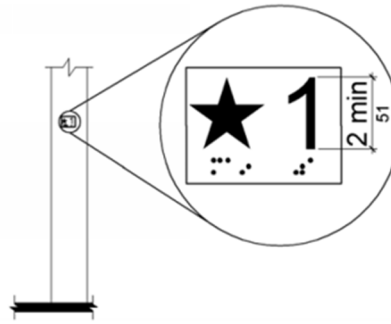


Figure 407.2.3.1  
Floor Designations on Jambs of Elevator Hoistway Entrances

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions specifically noted otherwise.

A. INSTALLATION

- i. Install signs level, plumb, and at heights indicated and to comply with ADA/ABA, with sign surfaces free of distortion and other defects in appearance.
- ii. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable, and at heights indicated to comply with ADA/ABA. Where not indicated or possible, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

B. CLEANING AND PROTECTION

- i. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END SECTION 101400 KUA SIGNAGE

**102113 KUA TOILET COMPARTMENTS**

1. SUMMARY

This section identifies the solid-polymer toilet and/or shower compartments at the first and second floor bathrooms of the building. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

- 061000 Rough Carpentry- blocking
- 092900 Gypsum Board
- 093000 Ceramic Tile
- 102800 Toilet and Bath Accessories

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Partition locations, sizes and attachment
Product Cut Sheets	X	- HDPE panel and accessories
Product Samples	X	Panel color
Mock-ups	NA	
Closeout submittals	X	Warranty Information
	X	Cleaning, maintenance, and replacement parts information

3. PRODUCTS

A. SOLID-POLYMER TOILET ENCLOSURES

- i. Manufacturer: Yemm and Hart (Origins), Scranton Products (Hiny Hider), Accurate Partitions Corp, Bradley Corp., or approved equal
- ii. Product: High-density polyethylene (HDPE) 1” thick panel, 100% post-consumer recycled content, floor anchored with overhead bracing.
- iii. Dimension: As shown on the Drawings.
- iv. Color: As chosen by architect from the full range of recycled content colors.

B. BRACKETS AND FITTINGS

- i. Manufacturer: Same as toilet enclosures.
- ii. Product: Double ear continuous bracket to top of tile, double ear stirrup brackets above tile, head rail and pilaster shoes.
- iii. Material: Aluminum or stainless steel.

C. HARDWARE AND ACCESSORIES

- i. Manufacturer: Same as toilet enclosures.
- ii. Material: Chrome-plated zamac or clear-anodized aluminum.
  - a. Hinges: Paired, self-closing adjustable.

- b. Latch and Keeper: Manufacturer's standard surface-mounted latch unit.
- c. Coat Hook: Manufacturer's standard.
- d. Door Pull: Manufacturer's standard.
- e. Anchorage: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads.

4. EXECUTION & QUALITY CONTROL

Install according to manufacturer's written instructions unless specifically noted otherwise.

A. PREPARATION

- i. Examine mounting surfaces for proper blocking.

B. FABRICATION

- i. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- ii. Door Size and Swings: Unless otherwise indicated, provide 24-inch wide, in-swinging doors for standard toilet compartments and 34-inch wide, out-swinging doors with a minimum 32-inch wide, clear opening for compartments designated as accessible.

C. INSTALLATION

- i. Stirrup Brackets: Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.
- ii. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- iii. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END SECTION 102113 KUA TOILET COMPARTMENTS

**102800 KUA TOILET ACCESSORIES**

1. SUMMARY

This section identifies the toilet accessories in all restrooms/water closets in the new and renovated spaces. This section also identifies accessories for the janitor’s closets.

Related Sections:

- 061000 Rough Carpentry (Architectural)
- 061010 Rough Carpentry (Structural)
- 092000 Gypsum Board
- 096500 Resilient Flooring Base and Accessories
- 220000 Plumbing

Provide quantities of each item described below as shown on plan drawings and interior elevations.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	<ul style="list-style-type: none"> <li>- Accessory schedule with type and quantity for each room using room numbers on the Drawings.</li> <li>- Location of wall blocking required for each accessory.</li> </ul>
Product Cut Sheets	X	<ul style="list-style-type: none"> <li>- Manufacturer's data sheets</li> <li>- Manufacturer finish charts</li> <li>- Environmental Product Declarations (EPDs)</li> <li>- Health Product Declarations (HPDs)</li> </ul>
Product Samples	NA	
Mock-ups	NA	
Closeout submittals	X	<ul style="list-style-type: none"> <li>- Warranty Information. Cleaning, maintenance, and replacement parts information , O &amp; M Information</li> </ul>

3. PRODUCTS

A. GENERAL

- i. Applicable Standards: all must be ACCESSIBILITY compliant and installed in accordance with ACCESSIBILITY guidelines

B. TOILET ACCESSORIES - DORMS

- i. Manufacturer: Bradley, Bobrick, Kimberly Clark, Georgia Pacific or approved equal similar to basis of design products below.
- ii. Products:
  - a. Semi-recessed paper towel dispenser/waste receptacle combination unit. Bobrick B-43944 or equal.
  - b. Toilet Paper dispenser with shelf. Satin finish stainless steel. Bradley Model 5263 or equal.
  - c. Waste Receptacles for Toilet Stalls: Free standing – PROVIDED BY OWNER.



- 
- d. Towel Dispenser: surface-mounted, roll type, approximately 14.5”h x 12.5”w x 9” deep – PROVIDED BY OWNER’S VENDOR, INSTALLED BY CONTRACTOR
    - 1. Locations: WC1, WC2, and WC 4. See drawings
  - e. Shower Curtain rod: Bobrick B-6107x60 Stainless Steel Heavy-Duty Shower Curtain Rod, 60"
  - f. Mirror: Mirror: Bobrick Model B-165, channel frame mirror – sizes per drawings
  - g. Robe/Towel hooks: Bobrick B-7672 Double Robe Hook Clothes Hook – polished stainless steel.
    - 1. Locations:
      - a. Showers: Include 2 hooks for each shower stall.
      - b. Single use restrooms – provide 1 hook for each at back of door.
- C. TOILET ACCESSORIES – FACULTY RESIDENCES
- i. Toilet Paper Holders: Kohler Components Wall Mounted Pivoting Toilet Paper Holder – Chrome Polished.
  - ii. Medicine Cabinet: Basco Slimline WM 326B-V – W (16” x 30”). Recessed. One each bathroom. Exception – Primary bathrooms get a flat, wall-mounted mirror (84” x 42”).
    - a. Curtain rod: Bobrick B-6107x60 Stainless Steel Heavy-Duty Shower Curtain Rod, 60"
  - iii. Towel Bars: (2) 24” per bathroom or per drawing. Kohler Components 24” Towel Bar. Polished Chrome Finish.
  - iv. Robe Hook: Delta Kayra Robe Hook – Polished Chrome.
  - v. Shower Curtains: by owner
- D. LIQUID SOAP DISPENSER
- i. Manufacturer: Bradley, Bobrick
  - ii. Product: Bobrick B-4112, 818615 or similar, 40 oz. capacity.
- E. GRAB BARS
- i. Manufacturer: Bradley, Bobrick or approved equal.
  - ii. Product: Bradley Model 832, Bobrick B-5806 straight grab bar or “L” corner grab bar. Sizes and locations as shown on the Drawings.
    - a. 1-1/4” (32mm) dia. tubing. Constructed of 18-gauge, type 304 satin-finish stainless steel tubing. Concealed mounting flange 1/8” thick, type 304 stainless steel plate, 2” W x 3 1/8” H, with screw holes for concealed anchors. Cover is 22-gauge, type 304 stainless steel with satin finish, 3 1/4” diameter. Cover snaps over mounting flange to conceal screws.
    - b. All grab bars to meet accessibility requirements for size, location, mounting, and installation.
- F. UNDERLAVATORY GUARDS
- i. Manufacturer: Porcelain shroud – knee contact guard. American Standard or equal.
  - ii. Product: Porcelain Shroud/Knee Contact Guard #0059.020EC.020 – WHITE
  - iii. NOTE: Coordinate with plumbing drawings and specs.
- G. JANITOR/UTILITY CLOSET ACCESSORIES

- i. Manufacturer: Bradley, Bobrick or approved equal.
  - ii. Location: Janitor's Closet 212
  - iii. Product:
    - a. Utility shelf: Bradley 7512-48, 12"x 48" or Bobrick B298x24 8"x 24"
    - b. 3' mop/broom holder: Bobrick B-2223x36
4. EXECUTION & QUALITY CONTROL  
Install according to manufacturer's written instructions unless specifically noted otherwise.
- A. INSTALLATION
- i. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated, conforming with ACCESSIBILITY regulations.
  - ii. Ensure appropriate blocking has been provided in all walls for all wall-mounted accessories.
  - iii. Grab Bars: Install to withstand a downward load of at least 250 lbf.

END SECTION 102800 KUA TOILET ACCESSORIES

**104400 KUA FIRE PROTECTION SPECIALTIES**

1. SUMMARY

This section identifies the portable fire extinguishers located in cabinets or wall mounted as shown on floor plans. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

061000 Rough Carpentry- blocking

092900 Gypsum Board

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	NA	- quantity and location of FE cabinets
Product Cut Sheets	X	- For each type of fire extinguisher and cabinet - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	NA	-
Mock-ups	NA	-
Closeout submittals	X	- Warranty Information
	X	- Operations and Maintenance information

3. PRODUCTS

A. PORTABLE FIRE EXTINGUISHERS - DORM

- i. Manufacturer: JL Industries or approved equal.
- ii. Product: Multipurpose Dry-Chemical Type.
  - a. "Cosmic" 10 lb ABC type extinguishers, UL Rating 4-A, 80-B:C
  - b. Comply with NFPA 10, "Portable Fire Extinguishers.
- iii. Locations: In cabinets where shown on the Drawing- 1 per floor.

B. PORTABLE FIRE EXTINGUISHERS – FACULTY RESIDENCES

- i. Manufacturer: JL Industries or approved equal.
- ii. Product: Multipurpose Dry-Chemical Type.
  - a. "Cosmic" 10 lb ABC type extinguishers, UL Rating 1-A, 10-B:C
  - b. Comply with NFPA 10, "Portable Fire Extinguishers.
- iii. Locations: Under kitchen sink and wall mounted with bracket upstairs hallway (see drawings).

C. PORTABLE FIRE EXTINGUISHER- ELECTRICAL

- i. Manufacturer: JL Industries or approved equal.
- ii. Product: "Cosmic" 5lb ABC type extinguishers, UL Rating 3-A, 40-B:C
  - a. Comply with NFPA 10, "Portable Fire Extinguishers.

- iii. Locations: Surface mounted at mechanical, Elevator and electrical equipment rooms and where shown on the Drawings.
- D. EXTINGUISHER CABINET AND BRACKETS
- i. Manufacturer: JL Industries or approved equal.
  - ii. Product: Academy 1027V10 aluminum semi-recessed cabinet with partial acrylic sheet glazing and or approved equal.
  - iii. Accessories: provide vertical decal for vision panel, color and style, by Architect.
    - a. In corridors and other communal areas, where shown on the Drawings.
  - iv. Provide with wall mounted brackets in lieu of cabinets only at locations specifically noted as wall mounted brackets/no cabinet.
- E. INSTALLATION MATERIALS
- i. Manufacturer: JL Industries or approved equal to match extinguisher.
  - ii. Product: Manufacturer's standard steel wall brackets where no cabinet is specified.

4. EXECUTION & QUALITY CONTROL

Install according to manufacturer's written instructions unless specifically noted otherwise.

A. EXAMINATION

- i. Examine fire extinguishers for proper charging and tagging.
- ii. Examine mounting surface for proper blocking.

B. INSTALLATION

- i. Install fire extinguisher, cabinets and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
  - a. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher, square and plumb, at locations indicated.
- ii. Provide gypsum board wrapped recess where recessed cabinet occurs in a rated assembly.

END SECTION 104400 KUA FIRE PROTECTION SPECIALTIES

**122413 KUA WINDOW ROLLER SHADES**

1. SUMMARY

This section identifies the window roller shades for all windows in the two dorm common rooms – lower windows only. In addition, this section addresses the best practices for installation.

Related Sections:

- 061000 Rough Carpentry
- 062023 Interior Finish Carpentry
- 064023 Interior Architectural Woodwork
- 085200 Windows
- 092900 Gypsum Board
- 099123 Interior Painting

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work. (including field verified dimensions)
Product Cut Sheets	X	- For each product listed - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	- For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. - Shadecloth Sample: Mark face of material to indicate interior faces. Test reports indicating compliance with specified fabric properties. Verification Samples: 6 inches (150 mm) square, representing actual materials, color and pattern.
Mock-ups	X	- Provide mock-up for architect review (in-situ may be acceptable, confirm with Architect)
Closeout submittals	X	- Warranty Information, O & M Information

3. PRODUCTS

A. ROLLER SHADE, MANUAL OPERATION AND ACCESSORIES

- i. Manufacturer: Mechoshade, OAE
- ii. BOD Product: Mecho/5 System,
- iii. Description: Manually operated glare-control fabric window shades.
- iv. Shade Type: Single Roller
- v. Universal drive capability to offset drive chain for reverse or regular roll shades.
- vi. Drop Position: Regular roll.
- vii. Mounting: Recessed in pocket, see details

- viii. Size: for full window coverages for lounge windows – main floor level only as indicated on drawings.
- ix. Fabric: light filtering, see section below
- x. Brackets and Mounting Hardware: SlimLine without fascia
  - a. As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
  - b. Material: Steel, 1/8 inch (3 mm) thick.
- xi. Multiple Shade Band Operation: Provide hardware as necessary to operate more than one shade band using a single clutch operator.
- xii. Roller Tubes:
  - a. Material: Extruded aluminum.
  - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
  - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
  - d. Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.
- xiii. Hembars: Designed to maintain bottom of shade straight and flat.
  - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
  - b. Profile: Rectangular.
  - c. Color: To be selected by Architect from manufacturer's standard color selection.
- xiv. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
  - a. Permanently lubricated brake assembly mounted on an oil-impregnated hub with wrapped spring clutch.
  - b. Brake must withstand minimum pull force of 50 pounds (22.7 kg) in the stopped position.
  - c. Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
- xv. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 pound (43 kg) minimum breaking strength. Provide upper and lower limit stops.
  - a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
- xvi. Accessories:
  - a. Fascia and ceiling pocket installation: As required per manufacturer's recommendations for the installation locations shown in the drawing details.
  - b. Color: by architect from manufacturer's standard offerings
- xvii. Warranty:
  - a. Roller Shade Hardware and Chain Warranty: Manufacturer's standard non-depreciating warranty for interior shading.
    - 1. Shade Hardware: 10 years unless otherwise indicated.
    - 2. Mecho/5 with ThermoVeil shade fabric: Manufacturer's standard 25 years.

3. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas, which are deemed owners responsibility.

B. SHADE FABRIC

- i. Manufacturer: Mechoshade, OAE
- ii. Description: Solar Shade cloths
- iii. Fabric: ThermoVeil Basket Weave:
- iv. Openness: 3%, 5% or 10% open, to be confirmed by owner's sample review
- v. Roll width and size: to provide mullion to mullion complete coverage for all "vitrine" windows. See drawings.
- vi. Color: As selected by Architect from manufacturer's full range of colors.
- vii. Warranty: see above

4. EXECUTION & QUALITY CONTROL

Store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. FABRICATION

- i. Field measure finished openings prior to ordering or fabrication.
- ii. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
  - a. Vertical Dimensions: Fill openings from head to sill with 1/4 inch, plus or minus 1/8 inch, space between bottom bar and window stool or finished floor.
  - b. Horizontal Dimensions:
    1. Fill openings from jamb to jamb.
    2. Symmetrical Light Gaps, both sides of shade. Shade width equal to jamb-to-jamb dimension of opening in which blind is installed less 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch.
- iii. Openings Requiring Continuous Multiple Shade Units with Separate Rollers: Locate roller joints at window mullion centers; butt rollers end-to-end.
- iv. Mounting Brackets: Designed for removal and reinstallation of blind without damaging blind and adjacent surfaces, for supporting blind components, and for bracket positions and blind placement indicated.
- v. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use

B. EXAMINATION

- i. Do not begin installation until substrates have been properly prepared.
- ii. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- iii. Start of installation shall be considered acceptance of substrates.

**C. INSTALLATION**

- i. Install level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.
  - a. Locate so exterior slat edges are not closer than 2 inches from interior faces of glass and not closer than 1 inch from interior faces of glazing frames through full operating ranges of blinds. Allow proper clearances for window operation hardware. Use mounting devices as indicated.
- ii. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric.
- iii. Demonstrate operation and maintenance of window shade system to Owner's personnel.

**D. CLEANING AND PROTECTION**

- i. Clean roller shade surfaces after installation, per manufacturer's written instructions.
- ii. Protect work protection and maintain conditions in a manner acceptable to manufacturer and Installer, and that ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
- iii. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

END SECTION 122413 KUA WINDOW ROLLER SHADES



**123213 KUA MANUFACTURED WOOD CASEWORK**

1. SUMMARY

This Section includes the following semi-custom kitchen cabinetry and vanity **bases in the faculty residences only**. In addition, this section addresses the fasteners, finishes, and best practices for installation.

Related Sections:

- 061000 Rough Carpentry
- 062023 Interior Finish Carpentry
- 064023 Interior Architectural Millwork
- 099123 Interior Painting and Staining

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Show locations of each item, dimensioned plans and elevations, large scale details, furring and blocking locations, size and location of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.
Product Cut Sheets	X	- For plastic laminate, panel and solid-surfacing materials, cabinet hardware and accessories, finishing materials.
Product Samples	X	Lumber with transparent finish for each type of wood proposed, plastic laminate and solid surfacing materials, cabinet door panel, cabinet hardware and accessories.
Mock-ups	NA	
Closeout submittals	X	Warranty Information, O & M Information

3. PRODUCTS

NOTE: WOOD PRODUCTS, SUBSTRATES, LAMINATES AND ADHESIVES SHALL NOT CONTAIN UREA FORMALDEHYDE.

A. WOOD KITCHEN CABINETS

- i. Basis of Design: Smart Cabinets Omaha – Maple or Birch or equivalent, square recessed panel, solid (DRHM6) square natural door with hardwood plywood box.
- ii. AWI Type of Cabinet Construction: Full Overlay.
- iii. AWI Construction Style and Type: Style B Face Frame, Type II, ½” plywood boxes.
- iv. WI Door and Drawer Front Style: Flat Panel Door “shaker” style, Flush Full Overlay flat panel Drawer Front.
- v. Drawer Hardware: heavy duty hardware- 70 lbs min.
- vi. Wood Species for hardwood: Maple or Birch as noted.
- vii. Wood Species and Cut for Exposed Surfaces: Maple, Solid or Grade A Sapwood, A1 book-matched, plain-sliced veneer panels.

- viii. Wood Species and Cut for semi-exposed surfaces: Maple veneer B2 grade, plain-sliced hardwood plywood.
  - ix. AWI Finish System: Acrylic Lacquer or Catalyzed Polyurethane.
  - x. Sizes as shown on the drawings.
  - xi. Warranty: Min. five-year warranty on material or workmanship defects.
- B. WOOD BATHROOM VANITIES**
- i. Basis of Design: Smart Cabinets Omaha – Maple or Birch or equivalent, square recessed panel, solid (DRHM6) square natural door with hardwood plywood box.
  - ii. AWI Type of Cabinet Construction: Full Overlay.
  - iii. AWI Construction Style and Type: Style B Face Frame, Type II, ½” plywood boxes.
  - iv. WI Door and Drawer Front Style: Flat Panel Door “shaker” style, Flush Full Overlay flat panel Drawer Front.
  - v. Drawer Hardware: heavy duty hardware- 70 lbs min.
  - vi. Wood Species for hardwood: Maple or Birch as noted.
  - vii. Wood Species and Cut for Exposed Surfaces: Maple, Solid or Grade A Sapwood, A1 book-matched, plain-sliced veneer panels.
  - viii. Wood Species and Cut for semi-exposed surfaces: Maple veneer B2 grade, plain-sliced hardwood plywood.
  - ix. AWI Finish System: FOR PAINTED FINISH
  - x. Sizes as shown on the drawings.
  - xi. Warranty: Min. five-year warranty on material or workmanship defects.
- C. STONE COUNTERTOPS**
- i. Product: Cultured Marble for all bathrooms and faculty residence kitchens.
  - ii. Manufacturer: Marcraft, Mincey Marble, or equal. Full color/pattern line.
  - iii. Colors, Patterns and Finishes: Honed finish.
  - iv. Location: Faculty Residence Kitchens and Bathrooms and Dorm Bathrooms.
  - v. Edge: Eased Edge – Top and bottom.
  - vi. Backsplashes: No stone backsplash – (Ceramic tile – see CT specification)
- D. ADHESIVES AND SEALANTS**
- i. General: Adhesives shall not contain urea formaldehyde.
  - ii. VOC limits:
    - a. Wood Glues: 30 g/L.
    - b. Multi-purpose Construction Adhesives: 70 g/L.
    - c. Contact Adhesive: 250 g/L.
    - d. Sealants and caulks: 70 g/L.
- E. HARDWARE**
- i. Include “D” ring pulls in faculty residences, knobs in all other units.

#### 4. EXECUTION & QUALITY CONTROL

Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

**A. FABRICATION, GENERAL**

- i. Interior Woodwork Grade: Provide Semi-Custom-grade interior woodwork complying with referenced quality standard.
- ii. Ease edges to radius indicated for the following:
  - a. Corners and edges of solid members and rails: 1/16"
- iii. Verify all dimensions in field prior to fabrication and installation.

**B. PREPARATION**

- i. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- ii. Examine shop-fabricated work for completion and quality. Complete work as required including back-priming.
- iii. Examine site for appropriate blocking as necessary.

**C. INSTALLATION**

- i. Install woodwork level, plumb true and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- ii. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- iii. Anchor woodwork to built-in blocking.

**D. ADJUSTING AND CLEANING**

- i. Repair damaged and defective woodwork and/or other finishes listed, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork and/or other finishes listed. Adjust joinery for uniform appearance.
- ii. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.
- iii. Protect finished woodwork from other construction as necessary to preserve integrity for final inspection and occupancy.

END SECTION 123213 KUA MANUFACTURED WOOD CASEWORK

**142600 KUA LULA ELEVATOR**

1. SUMMARY

This section identifies the Vertical Limited Use / Limited Access elevator included in the project. In addition, this section addresses the hoistway doors and best practices for installation.

On 3/23/23 Architect contacted NH Dept of Labor at (603) 271-2585 and was referred to Chief Elevator Inspector, Brian Morris. Architect spoke with Brian via cell (603-419-9104) and confirmed that the State of New Hampshire will allow machine room-less elevators.

This LU/LA elevator will travel from the new basement floor level up to the new second floor level of the New Kilton Dorm as well as the Welch Dorm, with a vertical travel distance of approx. 20' 5" with 3 stops. All 3 floors require the same side door configuration and require a 1R elevator layout

Related Sections:

061000            Rough Carpentry

092900            Gypsum Board

See Structural Drawings for the cast-in-place concrete pit.

See MEP Drawings for electrical service and fire alarm systems.

2. SUBMITTAL PROCESS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	X	- Wheelchair lift plans, sections, details, pit and hoistway dimensions, electrical and mechanical requirements, operation, control and signal systems.
Product Cut Sheets	X	- For each listed product. - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	- Exposed equipment finishes and Interior finish samples.
Mock-ups	NA	
Closeout submittals	X	- Warranty Information, Operations and Maintenance information

3. PRODUCTS

A. LU/LA Elevator

- i. Manufacturer: Savaria, or approved equal.
- ii. BOD Product: Orion MRL Traction control LU/LA Elevator
- iii. Enclosure: Provide full enclosure with 1hr fire rating.
- iv. Platform Size:        42" x 60" Type 1L for Kilton and 42" x 60" Type 1R for Welch Dorm
- v. Capacity: 1400 L.

- vi. Travel: +/-20' -5" Basement to Second Floor, 3 stops
- vii. Power Supply: 240 volt single phase, 40 amps, 60 Hz
- viii. Emergency Operation: Emergency battery back-up for lighting, alarm and emergency lowering.
- ix. Lighting: Manufacturer's Standard
- x. Cab Finishes:
  - a. Cab wall finishes: Standard finishes: Standard architectural white or black steel, stainless steel car operating panel, handrail and silver color trimmed light fixtures.
  - b. Cab Floor Finishes: Rubber Mat (by others – max. 5/8")
  - c. Cab Ceiling Finishes: Manufacturer's Standard
- xi. Control Station Finishes: Stainless steel
- xii. Hoistway Doors:
  - a. Automatic doors: Fire-rated two-speed steel cab doors in black or architectural white, with infrared closing sensors; automatic landing doors are finished with primer.

4. EXECUTION & QUALITY CONTROL

Deliver, store and install according to manufacturer's written instructions unless specifically noted otherwise.

A. COORDINATION

- i. Coordinate installation of sleeves, block outs, equipment with integral anchors, and other items that are attached to hoistway. Furnish templates, sleeves, equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- ii. Coordinate locations and dimensions of other work relating to wheelchair lift including pit; adjacent floors; electrical service; and location for external lift controls and equipment.

B. INSTALLATION

- i. Alignment: Coordinate installation of hoistway entrances with installation of lift for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until lift is in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- ii. Leveling Tolerance: 1/4 inch, up or down, regardless of load and travel direction

C. PROTECTION

- i. Provide cab with temporary covering to protect finishes from damage when in use during construction.

END SECTION 142600 KUA LULA ELEVATOR

## SECTION 21 00 00 – FIRE PROTECTION WORK

### PART 1 - GENERAL

#### 1.1 GENERAL REQUIREMENTS

##### A. Related Work Specified Elsewhere:

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Cutting and Patching is specified in Section 01 1731 Cutting and Patching.
5. Selective Demolition is specified in Section 02 419 Selective Demolition.
6. Flashing of Plumbing Work passing through roof is specified in Division 7.
7. Finish Painting is specified in Division 9.
8. Plumbing Work is specified in Division 22.
9. Mechanical Work is specified in Division 23.
10. Electrical Work is specified in Division 26.

##### B. Related Documents:

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

#### 1.2 DESCRIPTION OF WORK

##### A. The following outlines the overall scope of work required:

1. Kilton:
  - a. **The Existing Building and Faculty Residence B:** The existing Dorm and Existing Faculty Residence is provided with a wet pipe NFPA 13R system, the existing sprinkler alarm valve and 4" water service is located in the north side of the basement of the Existing Faculty Residence. This system shall be renovated, upgraded or replaced to provide a fully compliant NFPA 13 system to serve the Existing Dorm and New Faculty Residence B. Note: there are unheated spaces in the building which will require fire protection coverage including attics, porches for NFPA 13 compliance.
  - b. **New Dorm Building and Faculty Residence A:** Because of building limitations provide a separate sprinkler water service and alarm valve for the New Dorm Building and Faculty Residence A. Provide a fully compliant complete coverage NFPA 13 system in the building which will require fire protection coverage including attics, porches for NFPA 13 compliance.

2. Welch:
    - a. **New Dorm Building, New Faculty Residence and Faculty Residence:** Provide a new water service, alarm valve, backflow preventer and all heads and piping to serve the entire building, new and existing. Provide a fully compliant complete coverage NFPA 13 fire protection system including complete coverage for all spaces including attics, porches and concealed spaces.
  - B. This Section specifies provisions for sprinkler work. The contractor shall be responsible for providing a complete design and installation in compliance with this specification and NFPA, State of New Hampshire Codes and all local codes and ordinances.
  - C. Provide labor, materials and equipment necessary to complete work of this section, including but not limited to the following:
    1. Provide a complete NFPA 13 systems for both Kilton and Welch buildings including new and renovated areas. The work shall include, new alarm valves, piping and new piping, heads and accessories as required to provide complete wet pipe coverage for the building. For existing NFPA 13R systems, renovate, upgrade or replace existing systems as required to provide complete NFPA 13 coverage.
    2. Provide flow alarm, supervisory valves, drain valves, alarm bell and all required supervisory controls and accessories for a complete system.
    3. Conduct flushing of the new water service mains in compliance with NFPA 24, coordinate with site installation contractor and prepare and submit completed NFPA 24 flushing and testing certification form.
    4. The contractor shall be responsible for verification of existing conditions and the scope of pipe routing required to accommodate all new work. Submit complete coordination plans showing coordination with all trades including new and existing construction.
    5. Contractor shall provide hydraulically designed system including calculations and drawings indicating sizes, head locations and pipe routing. Provide plans and calculations as required by the authority having jurisdiction. Conduct hydrant flow tests as required to obtain hydraulic data needed for design.
  - D. Products specified in this Section with installation not in Contract include sprinkler cabinets with spare sprinklers of each style and sprinkler wrenches for each type of head. Deliver to the Owner's maintenance personnel.
- 1.3 ALTERNATES
- A. There are alternates which affect the fire protection work of this project.
  - B. Refer to Division 1 specifications and bidder instructions for additional, related information.
  - C. Alternates to the project which affect fire protection work are as follows:

1. Welch Faculty Residence fit-up – Base bid, the faculty residence shall be constructed core and shell, no fire protection installed. Alternate will be full fit up of the Welch Faculty Residence and complete sprinkler.
2. Kilton Faculty Residence A fit-up – Base bid, the faculty residence shall be constructed core and shell, no fire protection installed. Alternate will be full fit up of the Welch Faculty Residence and complete sprinkler.
3. Kilton Faculty Residence B fit-up – Base bid, the faculty residence shall be constructed core and shell, with minimal electrical installed. Alternate will be full fit up of the Welch Faculty Residence and complete sprinkler.
4. Existing Welch Renovation / Upgrades – Base bid, the existing faculty residence shall generally remain as it exists, with minimal fire protection modifications. Alternate will be full fit up of the Welch Faculty Residence and complete sprinkler.

#### 1.4 DEFINITIONS

- A. Pipe sizes used in this Section are nominal pipe size (NPS) specified in inches. Tube sizes are standard tube size specified in inches.
- B. Working plans as used in this Section refer to documents (including drawings and calculations) prepared pursuant to requirements in NFPA 13 requirements for obtaining approval of authority having jurisdiction.
- C. Other definitions for fire protection systems are included in referenced NFPA standards.

#### 1.5 SYSTEM DESCRIPTION

- A. Wet-Pipe Sprinkler System: System with automatic sprinklers attached to piping system containing water and connected to water supply so that water discharges immediately from sprinklers when they are opened by fire.
- B. Dry-Pipe Sprinkler System: System with automatic sprinklers attached to piping system containing air and connected to water supply so that water discharges immediately from sprinklers after air is expelled from the system after heads are opened by fire.
- C. Sprinkler System Protection Limits: All spaces within areas required by NFPA 13. Include storage room areas, each stair, and special applications areas.

#### 1.6 SYSTEM PERFORMANCE REQUIREMENTS

- A. Design and obtain approval from authority having jurisdiction for fire protection systems specified, including the State of New Hampshire Public Safety, Fire Safety Division and the Owner's Insurance Company Requirements.
- B. Minimum Pipe Sizes: Not smaller than sizes required NFPA 13 for piping and branches from standpipes to sprinklers.
- C. Conduct an on-site fire hydrant flow tests as required to obtain hydraulic data needed to prepare design for hydraulically calculated systems.



- D. Hydraulically design sprinkler systems according to:
1. Sprinkler System Occupancy Hazard Classifications: As follows:
    - a. Dorm Rooms Areas: Light hazard.
    - b. Storage Areas: Ordinary hazard.
    - c. Equipment Rooms: Ordinary hazard.
  2. Minimum Density Requirements for Automatic Sprinkler System Hydraulic Design: As follows:
    - a. Light Hazard Occupancy: 0.10 GPM over 1500 sq. ft. area.
    - b. Ordinary Hazard, Group 1 Occupancy: 0.15 GPM over 1500 sq. ft. area.
    - c. Special Occupancy Hazard: As determined by authority having jurisdiction.
  3. Maximum Sprinkler Spacing: As follows:
    - a. Dorm Room Spaces: 225 sq. ft./sprinkler
    - b. Storage Areas: 130 sq. ft./sprinkler
    - c. Mechanical Equipment Rooms: 130 sq. ft./sprinkler
    - d. Electrical Equipment Rooms: 130 sq. ft./sprinkler
    - e. Other Areas: According to NFPA 13.
- E. Components and Installation: Capable of producing piping systems with the following minimum working pressure ratings except where indicated otherwise.
1. Sprinkler Systems: 125 psig design sprinkler systems according to NFPA 13.
- F. Components and Installation: Capable of producing piping systems with the following minimum working pressure ratings except where indicated otherwise.
1. Sprinkler Systems: 125 psig

#### 1.7 SUBMITTALS

- A. Product data for fire protection system components. Include the following:
1. Complete system design drawings, equipment specifications, and hydraulic calculations.
  2. Valves.
  3. Alarm valves and accessories.
  4. Specialty valves, accessories, and devices.
  5. Alarm devices: Include electrical data.
  6. Sprinklers, escutcheons, and guards: Include sprinkler flow characteristics, mounting, finish, and other data.
- B. Sprinkler system drawings identified as "working plans," prepared according to NFPA 13. Submit required number of sets to authority having jurisdiction for review, comment, and approval. Include system hydraulic calculations. Plans shall be prepared by NICET

Certified Level III Designer. Do not proceed with installation or purchasing equipment until all drawings have been reviewed and approved by the Architect and Engineer.

- C. Test reports and certificates as described in NFPA 13. Include "Contractor's Material & Test Certificate for Aboveground Piping" and "Contractor's Material & Test Certificate for Underground Piping."
- D. Maintenance data for each type of fire protection specialty specified, for inclusion in "Operating and Maintenance Manual" specified in Division 1 Section "Project Closeout."
- E. Provide (2) copies of NFPA 25 "Standard for Inspection, Testing and Maintenance of Water Based Fire Protection Systems." Deliver to Owner's maintenance personnel.

**1.8 SLEEVES AND FIRE STOPPING:**

- A. Furnish and set sleeves to accommodate pipes passing through foundations, walls, floors, furring and ceilings. Cooperate with other Contractors in setting all sleeves. Sleeves shall be full thickness of construction.
- B. Sleeves shall be large enough to permit free movement of pipe where expansion and contraction occur and to permit insulation to run continuous. Provide U.L. listed fire barrier seals in ALL floor, walls, ceiling penetrations. Fill annular space between pipe and sleeve with U. L. approved fire retarding packing, rated for (1) hours minimum; provide (2) hour rating for sprinkler fire pump room and boiler room. See fire stopping details on the drawings.
- C. Sleeves through exterior walls below grade, through foundation walls, shall be watertight construction. Use "Link-seal", compression type neoprene link seals installed in sleeve or core drilled hole.
- D. Sleeves for steel pipe through exterior masonry wall, floors on grade and through fire partitions shall be of galvanized steel pipe, at least two pipe sizes larger than pipe passing through. Sleeves through interior walls and floors, ceilings, furring and partitions shall be steel pipe. Sleeves for copper piping shall be copper pipe, Type "L", minimum 2 sizes larger or large enough to allow for insulation. Fasten sleeves securely in floors, walls and partitions.
- E. All sleeves in exposed locations shall be set so escutcheon plates specified shall cover entire sleeve.

**1.9 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL Fire Protection Equipment Directory and FM Approval Guide and that conform to other requirements indicated.
- B. Listing/Approval Stamp, Label, or Other Marking: On equipment, specialties, and accessories made to specified standards.

- C. Listing and Labeling: Equipment, specialties, and accessories that is listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in "National Electrical Code," Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- D. Comply with requirements of authority having jurisdiction for submittals, approvals, materials, hose threads, installation, inspections, and testing.
- E. Comply with requirements of Owner's insurance underwriter for submittals, approvals, materials, installation, inspections, and testing.
- F. Licensed Designer: Submit design drawings, design calculations, and installation inspection reports. Include signature of registered NICET Level III Designer licensed in jurisdiction where Project is located, certifying compliance with specifications.
- G. Installer's Qualifications: Firms qualified to install and alter fire protection piping, equipment, specialties, and accessories, and repair and service equipment. A qualified firm is one that is experienced (minimum of 5 previous projects similar in size and scope to this Project) in such work, familiar with precautions required, and in compliance with the requirements of the authority having jurisdiction. Submit evidence of qualifications to the Architect upon request. Refer to Division 1 Section "Reference Standards and Definitions" for definition of "Installer."
- H. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:
  - 1. NFPA 13 "Standard for the Installation of Sprinkler Systems."
  - 2. NFPA 26 "Recommended Practice for the Supervision of Valves Controlling Water Supplies for Fire Protection."
  - 3. NFPA 70 "National Electrical Code."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Specialty Valves:

- a. Reliable Automatic Sprinkler Co., Inc
  - b. ASCOA Fire Systems, Figgie International Co.
  - c. Firomatic Sprinkler Devices, Inc.
2. Waterflow Indicators and Supervisory Switches:
- a. Reliable Automatic Sprinkler Co., Inc.
  - b. Potter Electric Signal Co.
  - c. Watts Regulator Co.
3. Sprinklers:
- a. Reliable Automatic Sprinkler Co., Inc.
  - b. Viking.
  - c. Central Sprinkler Corp.
4. Indicator Valves:
- a. Nibco, Inc.
  - b. Grinnell Supply Sales Co., Grinnell Corp.
  - c. Victaulic Company of America.
5. Fire Protection Service Gate and Check Valves:
- a. Nibco, Inc.
  - b. Victaulic Company of America.
  - c. Watts Regulator Co.
6. Grooved Couplings for Steel Piping:
- a. Victaulic Company of America.
  - b. Grinnell Supply Sales Co., Grinnell Corp.
  - c. Sprink-Line by Sprink, Inc.
7. Grooved Couplings for AWWA Ductile-Iron Piping:
- a. Gustin-Bacon Div., Tyler Pipe Subsid., Tyler Corp.
  - b. Victaulic Company of America.

**2.2 PIPES AND TUBES**

- A. Steel Pipe: ASTM A 53, Schedule 10 in sizes 6 inches to 2 ½ inches, black and galvanized, plain and threaded ends, for welded, threaded, and rolled-groove joints.
- B. Steel Pipe Sizes 2 inches and smaller: ASTM A 135, Schedule 40, threadable lightwall, black and galvanized, for threaded joints.
- C. All dry pipe system installed in unconditioned spaces shall be provided with galvanized steel piping.

2.3 PIPE AND TUBE FITTINGS

- A. Cast-Iron Threaded Flanges: ASME B16.1, Class 250, raised ground face, bolt holes spot faced.
- B. Cast-Iron Threaded Fittings: ASME B16.4, Class 250, standard pattern, with threads according to ASME B1.20.1.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Class 300, standard pattern, with threads according to ASME B1.20.1.
- D. Grooved-End Fittings for Ductile-Iron Pipe: ASTM A 536 ductile-iron or ASTM A 47 malleable-iron, AWWA pipe-size, designed to accept AWWA C606 grooved couplings. Include cement lining or Food and Drug Administration (FDA)-approved interior coating.
- E. Steel Fittings: ASTM A 234/A 234M, seamless or welded; ASME B16.9, butt welding; or ASME B16.11, socket-welding type for welded joints.
- F. Steel Flanges and Flanged Fittings: ASME B16.5.
- G. Grooved-End Fittings for Steel Pipe: UL-listed and FM-approved, ASTM A 536, Grade 65-45-12 ductile iron or ASTM A 47 Grade 32510 malleable iron, with grooves or shoulders designed to accept grooved couplings.

2.4 JOINING MATERIALS

- A. Flanged Joints for Ductile-Iron Pipe and Ductile-Iron or Cast-Iron Fittings: AWWA C115 ductile-iron or gray-iron pipe flanges, rubber gaskets, and high-strength steel bolts and nuts.
- B. Couplings for Grooved-End Steel Pipe and Grooved-End Ferrous Fittings: UL 213, AWWA C606, ASTM A 536 ductile-iron or ASTM A 47 malleable-iron housing, with enamel finish. Include synthetic-rubber gasket with central-cavity, pressure-responsive design; ASTM A 183 carbon-steel bolts and nuts; and locking pin, toggle, or lugs to secure grooved pipe and fittings.
- C. Couplings for Grooved-End Ductile-Iron Pipe and Fittings: UL 213, AWWA C606, ASTM A 536 ductile-iron housing, with enamel finish. Include synthetic-rubber gasket with central-cavity, pressure-responsive design, and ASTM A 183 carbon-steel bolts and nuts to secure grooved pipe and fittings.

2.5 FIRE PROTECTION SERVICE VALVES

- A. General: UL-listed and FM-approved, with 175 psig non-shock minimum working pressure rating. Valves for use with grooved piping may be grooved type.
- B. Gate Valves, 2 Inches and Smaller: UL 262, cast-bronze, threaded ends, solid wedge, outside screw and yoke, rising stem.

- C. Indicating Valves, 2-1/2 Inches and Smaller: Butterfly or ball type, bronze body with threaded ends, and integral indicating device. Indicator: Electrical 115 volts a.c., prewired, single-circuit, supervisory switch.
- D. Gate Valves, 2-1/2 Inches and Larger: UL 262, iron body, bronze mounted, taper wedge, outside screw and yoke, rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.
- E. Gate Valves, 2-1/2 Inches and Larger for Use with Indicator Posts: UL 262, iron body, bronze mounted, solid wedge disc, non-rising stem with operating nut and flanged ends.
- F. Swing Check Valves, 2-1/2 Inches and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze disc ring and flanged ends.
- G. Butterfly Check Valves, 4 Inches and Larger: UL 213, split-clapper style, cast-iron body with rubber seal, bronze alloy discs, stainless-steel spring and hinge pin.

## 2.6 SPECIALTY VALVES

- A. Wet Pipe Alarm Check Valves: UL 193, 175 psig working pressure, designed for horizontal or vertical installation, with cast-iron flanged inlet and outlet, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Provide trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, drip cup assembly piped without valves separate from main drain line, and fill line attachment with strainer. Option: Grooved-end connections for use with grooved-end piping.
- B. Dry Pipe Alarm Valves: UL 193, 175 psig working pressure, designed for vertical installation, with cast-iron flanged inlet and outlet, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Include trim sets for drain, electric sprinkler alarm switch, pressure gages, priming cup, main drain, ball drip, air control valve, and air relief valve. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
- C. Ball Drip Valves: UL 1726, automatic drain valve, 3/4-inch size, spring-loaded, ball check device with threaded ends.

## 2.7 SPRINKLERS

- A. Automatic Sprinklers: With heat-responsive element conforming to:
  - 1. UL 199, for applications except residential.
  - 2. UL 1626, for residential applications.
  - 3. UL 1767, for early-suppression, fast-response applications.
- B. Sprinkler types and categories are as indicated and as required by application. Furnish automatic sprinklers with nominal 1/2-inch orifice for "Ordinary" temperature classification rating except where otherwise indicated and required by application.
- C. Sprinkler heads shall be equal to the following models:

1. Sidewall sprinkler heads: Reliable Model F1RES 44 horizontal sidewall sprinkler, quick response, UL Listed.
  2. Upright Sprinkler Heads: Reliable Model F1FR-300, 165 deg. F temp rating, UL Approved, quick response, UL Listed brass finish head.
  3. Pendant Sprinkler Heads: Reliable Model F1Res-30, semi-recessed pendant heads, quick response, UL Approved, with chrome plated escutcheon.
  4. Dry Pendant Heads: Reliable Model G3FD, U.L. Listed, quick response, length to suite installation, chrome plated finish with chrome escutcheon.
  5. Attic Sprinklers: Central Model SINC4, back to back, single directional or HIP to suite installation, 175 psig working pressure, U.L. Listed, natural brass finish.
- D. Sprinkler Escutcheons: Materials, types, and finishes for following sprinkler mounting applications.
1. Sidewall Mounting: Chrome plated steel, one piece, flat, except for concealed type sidewall head which shall have a white cover.
  2. Ceiling: Chrome plated steel, one piece, flat.
- E. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler, UL Listed for specific head type. Provide wire guards for all heads located in basements, mechanical rooms and other locations where heads are subject to damage.
- F. Substitutions: Any approvals of substitutions of manufactures and models shall be made prior to bidding. A sample of all heads and guards shall be submitted to the Architect/Engineer for review and approval, prior to ordering.
- G. Sprinkler Cabinets: Finished steel cabinet and hinged cover, with space for minimum of 6 spare sprinklers, at least one of each type, plus sprinkler wrench for each head type, suitable for wall mounting. Include number of sprinklers required by NFPA 13 and 1 wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each style sprinkler on Project.
- 2.8 SPECIALTY SPRINKLER FITTINGS
- A. Specialty Fittings: UL-listed and FM-approved, made of steel, ductile iron, or other materials compatible with system materials and applications where used.
- 2.9 ALARM DEVICES
- A. Alarm Bell: provide 10" round exterior alarm valve and sign.
- B. Waterflow Indicators: UL 346, electrical-supervision type, vane-type waterflow detector, rated to 250 psig, and designed for horizontal or vertical installation. Include 2 SPDT (single-pole, double-throw) circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere, 125 volts AC (7 A, 125 VAC) and 0.25 ampere, 24 volts DC. (0.25 A, 24 VDC); complete with factory-set, field-adjustable retard element to prevent false signals and tamper-proof cover that sends a signal when cover is removed.

- C. Supervisory Switches: UL 753, for valves, electrical-supervision type, SPDT (single-pole, double-throw), normally closed contacts, designed to signal controlled valve in other than full open position.

#### 2.10 PRESSURE GAGES

- A. Pressure Gages: UL 393, 3-1/2 to 4-1/2 inches diameter dial with dial range of 0-250 psig.

#### 2.11 FIRE DEPARTMENT CONNECTIONS

- A. Wall-Type Fire Department Connections: UL 405, cast-brass body; NH-standard thread inlets according to NFPA 1963 and matching local fire department threads; and threaded NPS outlet. Include lugged cap, gasket, and chain; lugged swivel connection and drop clappers for each hose connection inlet; and round wall escutcheon plate with marking "AUTO SPKR "

1. Connections: One Siamese connection.
2. Finish: Polished chrome plated.

#### 2.12 DRY PIPE COMPRESSOR

- A. Provide reliable model air compressor for sprinkler systems. Features to include are; permanently lubricated oil-less compressor, direct drive with thermal protection.
- B. Mount on base at location shown on Drawings. Provide all required accessories and install per manufacturer's installation instructions.
- C. Unit shall be sized per manufacturer based on system volume. Provide 208V, 1 phase, 60 Hz and coordinate horsepower and voltage requirements with Electrical Contractor.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine roughing-in for hose valves to verify actual locations of piping connections prior to installing cabinets.
- B. Examine walls and partitions for suitable thickness, fire and smoke-rated construction, framing for cabinets, and other conditions where cabinets are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.2 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Refer to Part 2 - Products of this Section for detailed specifications on pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Piping may be joined with flanges instead of indicated joints. Use grooved-end fittings with grooved couplings that are made by the same manufacturer and that comply with listing when used together for grooved-coupling joints.



- B. Wet Pipe System - Sizes 2 inches and smaller from the following types:
  - 1. ASTM A 53, A 135, or A 795; Schedule 40 black steel pipe with threaded ends, cast-iron or malleable-iron threaded fittings, and threaded joints.
  - 2. ASTM A 53, A 135, or A 795; Schedule 40 black steel pipe with rolled-groove ends, grooved-end steel pipe fittings, and grooved-coupling joints.
  
- C. Wet Pipe System -Sizes 2-1/2 inches to 6 inches from the following types:
  - 1. ASTM A 53, A 135, or A 795; Schedule 10 black steel pipe with threaded ends, cast-iron or malleable-iron threaded fittings, and threaded joints.
  - 2. ASTM A 53, A 135, or A 795; Schedule 10 black steel pipe, welding type steel fittings, and welded joints.
  - 3. ASTM A 53, A 135, or A 795; Schedule 10 black steel pipe with rolled-groove ends, grooved-end steel pipe fittings, and grooved-coupling joints.
  
- D. Dry Pipe System - Sizes 2 inches and smaller from the following types:
  - 1. ASTM A 53, A 135, or A 795; Schedule 40 galvanized steel pipe with threaded ends, cast-iron or malleable-iron threaded fittings, and threaded joints.
  - 2. ASTM A 53, A 135, or A 795; Schedule 40 galvanized steel pipe with rolled-groove ends, grooved-end steel pipe fittings, and grooved-coupling joints.
  
- E. Dry Pipe System -Sizes 2-1/2 inches to 6 inches from the following types:
  - 1. ASTM A 53, A 135, or A 795; Schedule 10 galvanized steel pipe with threaded ends, cast-iron or malleable-iron threaded fittings, and threaded joints.
  - 2. ASTM A 53, A 135, or A 795; Schedule 10 galvanized steel pipe, welding type steel fittings, and welded joints.
  - 3. ASTM A 53, A 135, or A 795; Schedule 10 galvanized steel pipe with rolled-groove ends, grooved-end steel pipe fittings, and grooved-coupling joints.

### 3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use gate, ball, or butterfly valves.
  - 2. Throttling Duty: Use globe, ball, or butterfly valves.

### 3.4 JOINT CONSTRUCTION

- A. Grooved-End Pipe and Grooved-End Fitting Joints: Use grooved-end fittings and grooved couplings that are made by the same manufacturer and that are listed for use together. Groove pipe and assemble joints with grooved coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
  - 1. Groove Type: Cut.

2. Groove Type: Rolled.

- B. Brazed Joints: Use AWS A5.8, BCuP-3, or BCuP-4 filler metals.
- C. Mechanically Formed Outlet Joints: Use UL-listed procedure and follow forming equipment manufacturer's written instructions. Drill pilot hole in tube, form branch for collar, dimple tube to form seating stop, and braze branch tube into formed-collar outlet.

### 3.5 PIPING INSTALLATIONS

- A. Deviations from approved "working plans" for sprinkler piping require written approval from authority with jurisdiction. File written approval with the Architect prior to deviating from approved "working plans."
- B. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- C. Install unions adjacent to each valve in pipes 2 inches and smaller. Unions are not required on flanged devices or in piping installations using grooved couplings.
- D. Install flanges or flange adapters on valves, apparatus, and equipment having 2-1/2-inch and larger connections.
- E. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
- F. Install sprinkler piping with drains for complete system drainage.
- G. Install ball drip valves to drain piping between fire department connections and check valves, and where indicated. Drain to floor drain or outside building.
- H. Install alarm devices in piping systems.
- I. Hangers and Supports: Comply with NFPA 13. Install according to NFPA 13.
  - 1. Install hanger and support spacing and locations for steel piping joined with grooved mechanical couplings according to manufacturer's written instructions for rigid systems.
  - 2. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.
- J. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than 1/4 inch and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

**3.6 VALVE INSTALLATIONS**

- A. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13, manufacturer's written instructions, and the authority having jurisdiction.
- B. Gate Valves: Install fire-protection service valves supervised-open, located to control sources of water supply except from fire department connections. Where there is more than 1 control valve, provide permanently marked identification signs indicating portion of system controlled by each valve.

**3.7 SPRINKLER APPLICATIONS**

- A. Rooms without Ceilings: Upright and sidewall sprinklers, as indicated.
- B. Rooms with Suspended Ceilings: Pendent sprinklers, as indicated centered on ceiling tile, upright heads above ceiling for complete coverage.
- C. Sidewall quick response sprinklers with UL Listed guard, or concealed style pendant head or upright heads as indicated on Drawings.
- D. Special Applications: Use extended-coverage, flow-control, and quick-response sprinklers where indicated or required.
- E. Sprinkler Finishes: Use sprinklers with following finishes:
  - 1. Upright, Pendent, and Sidewall Sprinklers: Chrome-plated in finished spaces exposed to view.
  - 2. Concealed Sprinklers: Rough brass.

**3.8 SPRINKLER INSTALLATIONS**

- A. Install sprinklers in patterns indicated.
- B. Install sprinklers in suspended ceilings in center of acoustical panels and tiles.

**3.9 CONNECTIONS**

- A. Connect to specialty valves, hose valves, specialties, fire department connections, and accessories.
- B. Connect water supplies to sprinkler systems. Include backflow preventers.
- C. Electrical Connections: Power wiring is specified in Division 26.
- D. Alarm devices shall be wired to fire alarm system, as specified in Division 26.

**3.10 FIRE DEPARTMENT CONNECTION INSTALLATIONS**

- A. Install fire department connections of types and features indicated in locations indicated.

- B. Install ball drip valves at check valve in fire department connection where indicated. Pipe to drain

### 3.11 FIELD QUALITY CONTROL

- A. Perform field acceptance tests of each fire protection system.
  - 1. Flush, test, and inspect sprinkler piping systems according to NFPA 13 Chapter "System Acceptance."
- B. Replace piping system components that do not pass test procedures specified. Then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
  - 1. Report test results promptly and in writing to Architect.
  - 2. Report test results promptly and in writing to authority having jurisdiction when required.

### 3.12 CLEANING

- A. Clean dirt and debris from sprinklers. Replace sprinklers having paint other than factory finish with new sprinklers. Cleaning and reuse of painted sprinklers is prohibited.

### 3.13 COMMISSIONING

- A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturer, proceed as follows:
  - 1. Verify that specialty valves, trim, fittings, controls, and accessories have been installed correctly and operate correctly.
  - 2. Verify that specified tests of piping are complete.
  - 3. Check that damaged sprinklers and sprinklers with paint or coating not specified have been replaced with new, correct type of sprinklers.
  - 4. Check that sprinklers are correct type, have correct finish and temperature ratings, and have guards where required for applications.
  - 5. Check that potable water supplies have correct type of backflow preventer.
  - 6. Check that hose valves and fire department connections have threads compatible with local fire department equipment and have correct pressure rating.
  - 7. Fill wet-pipe sprinkler systems with water.
  - 8. Energize circuits to electrical equipment and devices.
  - 9. Adjust operating controls and pressure settings.
  - 10. Verify that fire pump and controls comply with NFPA 20, obtain full factory start-up for fire pump and controls, and submit full start-up report from factory.
- B. Coordinate with fire alarm system tests. Operate systems as required.

### 3.14 DEMONSTRATION

- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

- B. Schedule demonstration with at least 7 days advance notice.

END OF SECTION 21 00 00

**SECTION 22 05 00 - PLUMBING GENERAL REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 GENERAL REQUIREMENTS**

**A. Related Work Specified Elsewhere:**

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Plumbing Work passing through roof is specified in Division 7. Provide roof flashing boots for all plumbing roof penetrations for installation by the roofer.
5. Finish Painting is specified in Division 9.
6. Mechanical Work is specified in Division 23.
7. Electrical Work is specified in Division 26.

**B. Related Documents:**

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of Section 22 05 00 govern the work specified in this Section, where applicable.

**C. Reference to Drawings: All work to be performed is shown on Drawings listed at the end of this Section:**

1. This Contractor shall refer to the Drawings for a full comprehension of the work to be done and for conditions affecting the location and placement of equipment and materials. These Drawings are intended to be supplementary to the specifications and any work indicated, mentioned, or implied in either is to be considered as specified by both. Should the character of the work herein contemplated or any matter pertaining thereto be not sufficiently explained in the specifications or drawings, this Contractor may apply to the Architect/ Engineer for further information and shall conform to such when given, as it may be consistent with the original intent. The Architect/Engineer reserves the right to make any reasonable changes in location prior to installation at no expense to the Owner. All lines are diagrammatic and exact locations are subject to the approval of the Architect/Engineer.
2. Before submitting his Bid, this Contractor shall visit the site with the plans and specifications and shall become thoroughly familiar with all conditions affecting his work since the Contractor will be held responsible for any assumption made in regard thereto.
3. This Contractor shall, at all times, have a foreman or superintendent on the project authorized to make decisions and receive instructions as if the Contractor were present. The foreman or superintendent shall not be removed or replaced without the express approval of the Architect/Engineer after construction work begins.
4. This Contractor shall employ competent and experienced workmen at a regular schedule in harmony with the other tradesmen on the job. The Contractor shall also exercise care and supervision of his employees in regard to proper and expeditious layout of his work.

**D. Extent: This specification applies to the KUA Kilton/Welch Dormitories and Faculty Residences. The plumbing work required without limiting the generality thereof, includes the furnishing of all labor, materials, equipment, and services necessary for and reasonably incidental to the complete installation**

of all domestic water piping, plumbing fixtures, sanitary waste and vent piping, water heaters, condensate drain piping, insulation, and all other materials, equipment, and labor necessary, whether or not such items are specifically indicated on the drawings or in the specifications, to complete all mechanical systems in all respects ready for continuous and trouble free operation.

- E. Intent: It is the intent of the Contract Documents to include all work and materials necessary for erecting complete, ready for continuous use all mechanical systems as shown on the accompanying drawings or as hereinafter described. These Drawings shall be taken in a sense as diagrammatic; sizes of pipes, etc., and methods of running them are shown, but it is not intended to show every offset and fitting nor every structural difficulty that will be encountered during the installation of the work.
- F. Commissioning: It is the Owner's intent to directly hire the services of a commissioning agent through construction. The General Contractor shall be responsible for coordinating commissioning work with the commissioning agent.

1.1 ALTERNATES

- A. There are alternates which affect the fire protection work of this project.
- B. Refer to Division 1 specifications and bidder instructions for additional, related information.
- C. Alternates to the project which affect fire protection work are as follows:
  - 1. Welch Faculty Residence fit-up – Base bid, the faculty residence shall be constructed core and shell, no above slab plumbing installed. Alternate will be full fit up of the Welch Faculty Residence and complete plumbing system. The scope of the base bid work shall include:
    - a. Water line shall be stubbed through slab and drained.
    - b. Waste piping shall be roughed in below slab, traps shall be protected with glycol and capped.
  - 2. Kilton Faculty Residence A fit-up – Base bid, the faculty residence shall be constructed core and shell, no above slab plumbing installed. Alternate will be full fit up of the Welch Faculty Residence and complete plumbing system. The scope of the base bid work shall include:
    - a. Water line shall be stubbed through slab and drained.
    - b. Waste piping shall be roughed in below slab, traps shall be protected with glycol and capped.
  - 3. Kilton Faculty Residence B fit-up – Base bid, the faculty residence shall be constructed core and shell, no above slab plumbing installed. Alternate will be full fit up of the Welch Faculty Residence and complete plumbing system. The scope of the base bid work shall include:
    - a. Water line shall be stubbed through slab and drained.
    - b. Waste piping shall be roughed in below slab, traps shall be protected with glycol and capped.
  - 4. Existing Welch Renovation / Upgrades – Base bid, the existing faculty residence shall generally remain as it exists, with no plumbing modifications.

1.2 SUBMITTALS

- A. Refer to General Conditions for submittal provisions and procedures. Approval by the Architect/Engineer must be obtained prior to delivery of materials to the site.
- B. Shop Drawings: Within thirty (30) days of award of contract, the Mechanical Contractor shall submit electronic submittals in compliance with the requirements of Section 01340.
- C. Product Data: Submit manufacturer's specifications and installation instructions for each class of material or equipment and include other data as may be required to show compliance with these specifications.
- D. Test Reports: Submit certified test laboratory reports as necessary to show compliance with requirements.
- E. Colors: Colors of all materials shall be as selected by the Architect/ Engineer from the standard color ranges of each manufacturer from samples submitted as per above.

1.3 QUALITY ASSURANCE

- A. Equality of Materials: Equality of materials or articles other than those named or described in this Section will be determined in accordance with the CONDITIONS OF THE CONTRACT.
- B. Tests: This Contractor agrees to accept as final the results of tests secured by a qualified testing laboratory engaged by the Owner. Tests will be conducted in accordance with the CONDITIONS OF THE CONTRACT.
- C. Products:
  - 1. All materials shall be new, full weight and first class in every respect, without defects, and designed to function properly in that portion of the work for which they are intended and with the same brand of manufacturers for each class of material or equipment.
  - 2. Equality of material or equipment other than those named or described in this Section will be determined in accordance with the revisions of the Contract and as specified further herein.

1.4 REFERENCE STANDARDS

- A. The work shall be performed in such a manner as to conform to the Codes and Regulations governing such work, as may be required by Local and State Ordinances. This Contractor and his Subcontractors shall inform themselves of all State and Federal work safety rules and regulations, including the latest provisions of the Occupational Safety and Health Act of 1971 and all subsequent provisions. All workmen employed on the project shall be instructed in the requirements and shall observe same at all times.
- B. All work installed under these Plans and Specifications must be installed in strict accordance with the requirements of all local, state and other departments having jurisdiction, the utility companies, and with the requirements of the Underwriters' Laboratories, State of New Hampshire Building Code, New Hampshire Plumbing Code, Fire Protection Regulations, Factory Mutual, and/or similar codes applied thereto. Where provisions of the Contract Documents conflict with any codes, or rules and regulations,



the latter shall govern. Where the contract requirements are in excess of applicable codes, rules and regulations, the Contract provisions shall govern.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: This Contractor shall provide for the delivery of all his materials and fixtures to the building site when required so as to carry on his work efficiently and to avoid delaying his work and that of other trades.
- B. Storage and Handling: This Contractor shall, at all times, fully protect his work and materials from injury or loss by others. Any injury or loss which may occur shall be made good without expense to the Owner. The Contractor shall be responsible for the proper protection of all his materials until the building is accepted by the Owner.

1.6 PERMITS AND CODES

- A. This Contractor shall obtain and pay for all licenses and permits and shall pay for all fees and charges for the connection to outside services and use of property other than the site of the work for storage of materials or other purposes.
- B. Work under this Contract shall be installed to comply strictly with latest applicable editions of the New Hampshire Plumbing and Building Code, including Supplements thereto and local amendments if any, current State of New Hampshire Guidelines for Energy Efficient Commercial Construction, Underwriters' Laboratories Regulations, including the latest amendments, ASHRAE Guide, National Electric Code and all codes, regulations, and requirements of all Municipal, State, Federal and other public or private authorities which have jurisdiction. In each case, codes, regulations and standards are minimum requirements and where the contract documents exceed these minimum conditions, the contractor shall comply with the more stringent requirements.

1.7 MATERIALS AND SUBSTITUTIONS

- A. All materials shall be new and conform to standards established in plans and specifications.
- B. Equipment, materials or items of other manufacturers, of equivalent design, quality and capacity, will be considered as substitutes to those specified or noted on the Drawings. Engineer reserves the right to reject any substitute offered for items specified or noted on Drawings.
- C. Substitute material and equipment, where requested or proposed by Contractor, shall be itemized and shall show cost to Owner whether it be an "addition" or "deduction" or "no change in cost" to the Base Bid price. It shall be held that no change in contract completion time will occur should Engineer elect to accept any alternate unless such time is specifically stated in the Contractor's Bid.
- D. Materials and equipment not approved shall not be used in construction.

1.8 WORKMANSHIP

- A. All work shall be executed in a workmanlike manner, presenting a neat, mechanical appearance when completed. Work not approved by Architect or Engineer shall be replaced by Contractor without additional charge to Owner. Align, level and adjust for satisfactory operation, install so that connecting

and disconnecting of piping and accessories for inspection, operation, maintenance and repair. Minor deviations from indicated arrangements may be made as approved.

- B. Piping shall be run as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, neatly spaced. Check with other trades and prevent interference.
- C. Piping shall be cut and fabricated accurately according to measurements taken at the building.
- D. This Contractor shall perform his work so as to cause no delay or interference with the progress of the general construction of the building and the work of the other trades or subcontractors. Materials and equipment shall be installed as soon as conditions or construction permit. Confer with all other trades or Subcontractors as to location of pipes, ducts, conduit and apparatus to avoid interference during installation.

#### 1.9 CLEANING AND ADJUSTMENT

- A. Each Contractor shall clear away all debris, surplus materials, etc., resulting from his work or operation, leaving the job and equipment furnished in a clean, first-class condition.
- B. Cleaning, Flushing and Inspecting: Clean, flush and inspect each piping system in accordance with requirements of Section 22 05 01, Plumbing Basic Materials and Methods Section.
- C. Painting of materials and equipment furnished under the mechanical portion of the Contract will be done under the General Construction Contract. The Contractors shall, however, refinish and restore to the original condition and appearance, all equipment which has sustained damage to the manufacturer's enamel or paint finish. Materials and workmanship shall be equal to the requirements of the General Construction Contract.

#### 1.10 CERTIFICATES, DOCUMENTS AND INSTRUCTIONS

- A. Certificates and documents listed below for the convenience of Owner and Contractors are required under Mechanical and Electrical Section of the specifications. Previous to final payment, Contractor shall deliver copies of all such certificates and documents to the Architect for approval:
  - 1. All test data specified to be submitted under "TEST".
  - 2. Operating and Maintenance instructions for mechanical and electrical equipment and systems.
  - 3. All approved shop drawings.

#### 1.11 MISCELLANEOUS STEEL SUPPORTS

- A. See drawings and schedules for equipment and materials that need to be fastened to and/or supported by the structure. Furnish and install all necessary anchor bolts, inserts, steel beams, bars, bearing and leveling plates and incidental items as may be needed to install the work. Items to be built into masonry and concrete must be furnished to the respective trade at the proper time to be built-in and shall include instructions and templates for their installation, unless it is explicitly shown or specified otherwise.

**1.12 REFERENCE STANDARDS AND INDUSTRY SPECIFICATIONS**

- A. Any material or operation specified by reference to published specifications of a manufacturer, a society, an association, a code or other published standard, shall comply with requirements of the listed document which is current on date of receipt of Bids. In case of a conflict between referenced documents, the one having more stringent requirements shall govern. Any Contractor, when requested, shall furnish a sworn affidavit from the manufacturer certifying that materials and/or manufactured products delivered to the job meet the requirements specified. However, such affidavit shall not relieve the Contractor from responsibility of complying with any added requirements of the project specifications.

1. International Building Code (IBC)
2. State of New Hampshire Plumbing Code
3. American Society of Mechanical Engineers (ASME)
4. Underwriters Laboratories (U.L.)
5. American National Standards Institute, Inc. (ANSI)
6. National Electrical Manufacturers Association (NEMA)
7. American Society of Testing Materials (ASTM)
8. National Electrical Code (NEC)
9. National Fire Protection Association (NFPA)

**1.13 WARRANTY**

- A. The Contractor shall and hereby does warrant that all work executed and all plumbing equipment shall be free from defects of workmanship and materials for a period of one year from date of Substantial Completion of this work. The Contractor further agrees that he will, at his own expense, repair and replace all such defective work and all other work damaged thereby which becomes defective during the term of the Guarantee/Warranty.
- B. Use of plumbing systems shall not constitute Substantial Completion and shall not constitute the start of the specified guarantee period.

**1.14 RECORD DRAWINGS**

- A. Refer to General Conditions for Record Drawings.
- B. Record Drawings shall reflect all changes from the Contract Drawings whether by change order or by field conditions. Principal dimensions of concealed work, water hammer arrestors, trap primers, control valves, and for piping installation including all major risers, valves, shut-offs and drains. Valve numbers shall be added as soon as established.
- C. Provide electronic PDF format copies of all as-built drawings.
- D. Provide 2020 AutoCAD format drawing of all as-built drawings.

**1.15 OPERATION AND MAINTENANCE MANUALS**

- A. After all final tests and adjustments have been completed, fully instruct the proper Owner's representative in all details of operation for equipment installed. Supply qualified personnel to operate

equipment for sufficient length of time to assure that Owner's representative is properly qualified to take over operation and maintenance procedures.

- B. Furnish the Architect/Engineer, for his approval, four copies of an Operation and Maintenance Manual. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the name and location of the equipment or the building, the name of the Contractor, and the Contract number. The manual shall have a table of contents with tab sheets placed before each section. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manuals shall be bound in hard binders or an approved equivalent.
- C. The manual shall include, at a minimum, the following information:
  - 1. Description of systems.
  - 2. Description of start-up, operation, and shutdown procedures for each item of equipment.
  - 3. Winter/summer changeover procedures.
  - 4. Schedule of adjustment, care, and routine maintenance for each item of equipment.
  - 5. Lubrication chart.
  - 6. Wiring and control diagrams with data to explain detailed operation and control of each item of equipment.
  - 7. Valve chart.
  - 8. List of recommended spare parts.
  - 9. Copies of all service contracts.
  - 10. List of all names, addresses, and phone numbers of all Subcontractors as well as the local representative for each item of equipment.
  - 11. Copies of all approved Shop Drawings.
  - 12. Copies of all Test Reports.
  - 13. All warranties for materials and equipment.
  - 14. All certificates of approval from applicable agencies for systems installed on this project.
  - 15. Complete Equipment start-up reports prepared by factory authorized technicians.
  - 16. List of all stock items and spare parts.

#### 1.16 PROTECTION

- A. Work shall include protecting the work and material of all other trades from damage by work or workmen, and shall include making good all damage thus caused.
- B. The Contractor shall be responsible for work and equipment until finally inspected, tested, and accepted; protect work against theft, injury, or damage; and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing or foreign material.
- C. Work includes receiving, unloading, un-crating, storing, protecting, setting in place, and connecting-up completely any equipment supplied. Work shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged by reason of mishandling or failure to protect on the part of the Mechanical Contractor.
- D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt, and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

1.17 IDENTIFICATION OF EQUIPMENT AND PIPING SYSTEMS

- A. All equipment shall be identified with a 3" wide by 1" high black phenolic nameplate with 1/2" high white letters. Nomenclature shall be required to accurately identify its respective equipment. Nameplates shall be secured to the equipment with suitable screws.
- B. All piping systems shall be identified with direction of flow arrows and printed color coded bands of plastic tape applied after finish painting of insulation and bare pipe. Letters to be not less than 1" high. Note color and working on valve tag chart. Pipe labels to be Seton Name Plate Corporation, Style B wrap around vinyl tape or other approved equal completely wrapped around the pipe and adhered to itself. Tape and label background colors shall conform to ASA recommendations.
  - 1. Label all exposed piping which is not in the same room with major equipment at least once in each room through which the pipes pass, but never more than 15' between labels.
  - 2. Label all piping adjacent to major equipment and include zone or equipment numbers when there are two or more pieces of similar equipment.
  - 3. Direction of flow arrows shall be applied to piping adjacent to all labels and at each piece of equipment.
- C. Provide brass stamped valve tags for all valves, including service, (DHW) domestic hot water, (DHWR) domestic hot water recirculation (DCW) domestic cold water. All valves shall be numbered and recorded on the as-built drawings. A valve chart shall be prepared and shall be posted in frames in the mechanical room and a copy shall be included in all Operation and Maintenance manuals.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 22 05 00

## SECTION 22 05 10 - PLUMBING BASIC MATERIALS AND METHODS

### PART 1 - GENERAL

#### 1.1 GENERAL REQUIREMENTS

##### A. Related Work Specified Elsewhere:

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Plumbing Work passing through roof is specified in Division 7. Provide roof flashing boots for all plumbing roof penetrations for installation by the roofer.
5. Finish Painting is specified in Division 9.
6. Mechanical Work is specified in Division 23.
7. Electrical Work is specified in Division 26.

##### B. Related Documents:

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of Section 22 05 00 govern the work specified in this Section, where applicable.

#### 1.2 GENERAL PROVISIONS

- A. Unless otherwise indicated, the materials to be furnished under this Contract shall be the standard products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design that complies with the Specification Requirements.
- B. Each major item of equipment shall have the manufacturer's name, address, serial and model numbers on a plate securely attached to the item. Each length of pipe fitting and device shall be labeled with the maker's name or symbol and weight or class of product.
- C. The Contractor shall obtain detailed information from the manufacturers of apparatus which he is to provide for the proper methods installation. He shall also obtain all information from the General Contractor and other subcontractors which may be necessary to facilitate his work and the completion of the whole project. The Contractor shall coordinate his work with the General Contractor. All work shall be installed in a manner and in locations approved by the Engineer.
- D. The Contractor shall keep himself fully informed as to the shape; size and position of all openings and foundations required for his apparatus and shall give full information to the General Contractor sufficiently in advance. He shall furnish all supports herein specified, so that the General Contractor may build same in place. In the case of failure on the part of the Contractor to give proper information as noted above, he shall assume the cost of having the work done by others.
- E. All plumbing equipment shall be delivered to the site in the original sealed containers or packages bearing the manufacturer's name and brand designation. Piping shall be cleaned inside to remove dirt and loose scale, etc. Water piping shall be flushed out prior to testing of equipment. All open ends of pipe shall be capped or plugged during the construction period to prevent entrance of foreign materials. No pipe shall be installed outside of the building or in an exterior wall unless adequate provision is made to protect such pipe from freezing. Escutcheons shall be provided for all exposed piping passing through

finished wall, floor or ceiling assemblies. The General Contractor shall at all times protect his work, materials and equipment from any loss or damage.

- F. All equipment and piping shall be supported from the building structure. In general, all equipment and piping shall be installed concealed above ceilings or in walls, except as otherwise noted on the Drawings.
- G. All motors, controls, and wiring provided from factory, shall be UL tested and labeled. All field installed 120 VAC control panels are also required to bare a UL label, for the tested assembly no field modifications to UL tested and labeled assemblies shall be permitted.

### 1.3 ELECTRICAL WORK

- A. Electrical equipment furnished by this Contractor and wired under Division 26, Electrical.
  - 1. Motors, magnetic starters with auxiliary contacts and other controls of devices for all packaged units.
  - 2. Disconnect switches when specified to be furnished with equipment.
- B. Electrical equipment furnished, installed and wired by this Contractor:
  - 1. Low voltage controls, including relays.
  - 2. Interlocking and low voltage control wiring between controls, motor starters, relays, motors, and miscellaneous controls.
  - 3. All wiring shall be in accordance with Division 26, Electrical.
- C. Electrical equipment furnished, installed and wired under Division 26 work. The Electrical Contractor shall furnish and mount a magnetic motor starter for each motor where motors are not factory furnished in a package which includes motor controls.
- D. Motors:
  - 1. Motors shall be designed voltage and phase shown on the drawings, 60 Hz power, except as otherwise shown on the Drawings. Unless otherwise specified or shown on the Drawings, all motors shall have open drip-proof frames, Class F insulation and continuous duty classification based on a 40 degree C ambient temperature.
  - 2. Motors shall be sized for the service intended and all motors shall have 1.15 service factor. The HP of the motors specified or shown on the Drawings is for guidance. The Contractor shall, at no extra charge to the Owner, make all necessary adjustments, including all electrical work for the equipment furnished by him. Prior to substantial completion, the Contractor shall verify all overloads for all motors furnished by him.
  - 3. Motor Efficiencies for plumbing equipment shall meet or exceed the requirements of the New Hampshire Energy Standards.

### 1.4 TESTING OF SYSTEMS

- A. General:
  - 1. Each system shall be tested in accordance with the governing regulations and as specified herein. The Contractor shall furnish all certificates of compliance in triplicate to the Engineer.
  - 2. Upon completion of fabrication and before enclosing, insulating or concealing in any way, all piping, mains and joints shall be tested for leaks at one and one-half their normal working pressures.
  - 3. Provide test pumps, meters, gauges and other instruments and materials to test plumbing systems, as specified herein.

4. Before testing piping, remove or otherwise protect from damage all specialties and equipment not designed to withstand test pressures.
  5. The Contractor shall notify the Engineer, in advance (min. 48 hours) of scheduled tests so that the Engineer may have a representative present during any or all tests. Repeat all tests, as required, to prove system tight and in perfect operating condition.
  6. All pipe lines shall be blown or flushed clean before tests are conducted.
  7. Testing may be done in sections to facilitate construction.
  8. The Contractor must accommodate his testing operation to the progress of the project as a whole and correct all defects appearing under tests and repeat the tests until all parts of the work have withstood them successfully. Screwed piping shall be made tight without caulking. When the work is presented for acceptance, all valve stem packing must be new and without leaks and all gauges must be in place and reading accurately. The Contractor shall make and remove all temporary piping connections required for the test and shall dispose of test water and all wastes after tests. He shall leave all work in good order, ready for full use.
- B. Water Systems:
1. All domestic cold, hot and recirculating piping shall be tested hydraulically at 150 psi at the lowest floor level, before fixtures are connected. Maintain test for four (4) hours with no appreciable drop in pressure.
- C. Sanitary Waste and Vent Systems:
1. The new sanitary, waste and venting systems shall be tested when completely roughed-in, excepting fixture traps, by plugging or capping all outlets except stacks above the roof and filling the entire system with water. Plumbers testing plugs shall be used in openings where required. Minimum ten ft. (10') head above highest fixture level. The tests may be done using air and in sections to facilitate construction.
- D. Condensate Drainage Systems:
1. The new shall be tested using compressed air a 10 PSIG.
- E. Additional Testing Requirements: If during the process of installing the specified systems the Engineer requires additional independent testing to confirm conformance with these specifications the contractor shall be responsible for paying for and providing all testing deemed appropriate by the Engineer. Additional testing requirements will be invoked if there is a question relative to quality, workmanship or methods utilized during the installation of the work. The Engineer shall select and approve any or all independent testing agencies required for any and all such testing. The contractor shall also be responsible for all costs associated with removal and replacement of sections of the work required for testing.
- 1.5 OPERATING TESTS
- A. Conduct operational test of all systems, equipment devices and accessories.
  - B. During operating test, arrange and pay for services of qualified and authorized representative of manufacturers of the equipment and controls, as directed by the Engineer. Included in this service will be instructions to the Owner or his representative of the operating and maintenance of respective equipment and controls.
  - C. Test and set safety and relief valves to specified relief pressure.
  - D. Test and adjust all gauges, thermostats, meters and other equipment, after installation, to assure accurate operation.



- E. Adjustments and tests shall be repeated until systems operate in accordance with Contract requirements.
- F. Engineer shall inspect operating tests only after Contractor has completed them satisfactorily and requested inspection.

## PART 2 - PRODUCTS

### 2.1 PIPE AND FITTINGS

- A. General: Provide pipe and fittings of the type grade, size and weight indicated for each piping system as shown on the Drawings and specified here herein.
- B. All Domestic Water Distribution Piping: shall be type "L" hard copper tubing with wrought copper fittings for solder fitting assembly. Alternate piping for lines branch lines serving individual fixtures and bathroom groups,  $\frac{3}{4}$ " and smaller exterior to the Boiler, Mechanical Rooms may be plumbed using Watts WaterPEX® cross-linked polyethylene pipe or approved equal, and all joints shall be made using Watts brass CrimpRing™ and/or poly-alloy CrimpRing™ fittings using either the Watts copper CrimpRing™ or stainless steel CinchClamp™ crimping methods as outlined in the Watts WaterPEX® Installation Guidelines. Tubing shall be rated 160psi @ 73.4°F. Tubing shall be color coded blue for cold water and red for hot water.
- C. Underground water lines shall be continuous PEX piping with no joints below slab, piping shall be run in PVC sleeve and shall be insulated with 1" thick insulation as specified.
- D. Sanitary Waste and Vent Piping: All soil, waste and vent piping shall be ASTM D-1785, and ASTM D-2665 schedule 40, PVC-DWV pipe. All joints shall be cut square, de-burred, cleaned and then primed with a colored solvent based primer. Use solvent based cement to welded fittings following primer application.
- E. Condensate Drainage Piping: Schedule 40 PVC, use drainage pattern fittings.
- F. Fittings:
  - 1. Copper pipe fitting shall be wrought copper solder joints, ANSI B-16.22, streamlined pattern joints and shall be made with "Silverbrite" lead free solder with non-corrosive flux.
  - 2. Cast-iron threaded fittings where required shall be ANSI B-16.4, class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B-1.20.2.
  - 3. Malleable-iron threaded fittings where required shall be ANSI B-16.3, Class 300, standard pattern, for threaded joints. Threads shall conform to ANSI B-1.20.1.
  - 4. Cast bronze flanges where required shall be ANSI B-16.24, Class 300; raised ground face, bolts spot faced.
  - 5. Unions shall be of the same class and material as the pipe and fittings of the system in which they are installed.
  - 6. Dielectric unions: To prevent corrosion caused by dissimilar materials provide dielectric unions equal to Watts Series 3000, with materials to match piping system. Flanged dielectric fittings shall be equal to Watts Series 3100 with materials to match piping system.
- G. Joining Materials:
  - 1. Gaskets for flanged joints shall be full-faced for cast iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A-21.11, B-16.22, or B-16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.
  - 2. Welding materials shall comply with Section II, Part C ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

3. Brazing materials shall comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

## 2.2 VALVES

### A. General:

1. Except as otherwise indicated, provide factory-fabricated valves of the type, body material and pressure class indicated. Where type or body material is not indicated, provide proper selection as determined by Installer for installation requirements, with pressure class selected from MSS or ANSI Standards based on the maximum pressure and temperature in the piping system. Except as otherwise indicated, provide valve size same as connecting pipe size.
2. For information only, submit two (2) copies of manufacturer's product data including dimensions, sizes, end connections, weights and installation instructions. Include instructions on repacking and repairing valves.
3. Valves shall be Watts, Milwaukee or Apollo. Valve type and numbers noted herein establish standard of type and quality. Valves 3" and larger shall have flanged ends; 2-1/2" and smaller have screwed ends for screwed piping and solder joint ends for copper tube piping. Provide valves for services listed below and of the following types.

### B. Domestic Water Service:

1. NOTE: ALL VALVES TO BE LEAD FREE.
2. Ball Valves: Ball valves for plumbing service shall be equal to Watts No. LFB-6000, bronze body, 600 lb. W.O.G., chrome plated ball and stem, extended handle to accommodate insulation thickness, PTFE seat and seals, screwed ends or B-6001 sweat ends, virgin PTFE seats and seals.
3. Check Valves: Watts series CVS, solder ends, series CV screwed ends, bronze body, 200 lb. W.O.G.
4. Drain Valves: Watts No. LFB-6000, bronze body, chrome plated ball and stem, screwed ends, No. B-6001 sweat ends. Provide cap and chain, with 1/2" I.P.S. to 3/4" hose.
5. Balancing Valves: Bell and Gossett, lead free, with temperature/pressure readout ports, valve to be sized based on terminal flow rate. Handle shall be lockable type with memory stop.

## 2.3 SPECIALTIES

- A. Furnish and install pipe line type thermometers where specified and/or shown on the Drawings.
- B. Thermometers shall be H.O. Trerice Catalog No. A40507 or approved equal, with 9" scale, adjustable angle, and separable socket.
- C. Thermometers shall be installed so as to be easily read while standing on the floor.
- D. Furnish and install pressure gauges where specified and/or shown on the Drawings. Gauges shall be Trerice No. 450B with 4-1/2" dial, range as shown or approved equal to U.S. Gage or Crosby-Ashton. Each gauge shall be provided with a 1/4" ball valve gauge isolation valve. Gauges shall be installed so as to be easily read while standing on the floor. Provide pulsation dampener.

## 2.4 SUPPORTING DEVICES

- A. General: All piping shall be rigidly supported from the building structure by means of approved hangers and supports. This Contractor shall furnish and install all necessary intermediate support steel and the proper hanging of all piping and equipment. Chains, strap, perforated bar or wire hangers shall not be

permitted. Hangers for insulated piping shall be installed outside of insulation and provided with insulation protection saddles. Saddle shall be 12" long, 1/2 the circumference in width and 16 gauge for pipe 3" and larger and 6" long by 20 gauge for pipe 2-1/2" and smaller.

- B. All support components shall conform to Manufacturer's Standardization Society Specification SP-58. The hangers shall adequately support the piping system. They shall be located near or at changes in piping direction and at concentrated loads. They shall provide vertical adjustments to maintain pitch required for proper drainage and allow for expansion and contraction of the piping.
- C. Hangers shall be constructed of malleable or wrought iron. Where in contact with pipe hangers supporting copper pipe shall be copper-plated.
- D. Install all hangers straight and true, and in perfect alignment. Locate no hangers near couplings, fittings or bends in piping without making provisions for expansion.
- E. Where groups of three or more pipes occur, they may be supported with trapeze hangers, using two hangers as specified, with a capped pipe cross member.
- F. For vertical piping, support steel and copper pipe at every floor, with MSS Type 8 riser clamp.
- G. All pipe hangers shall be large enough to encompass the insulation, using a metal galvanized shield, so that vapor barrier jacket will not be broken or crushed.
- H. Inserts in the concrete slab shall be drilled in by the Contractor. Inserts driven in by explosive charges shall not be permitted. Inserts shall be of the type to receive a machine bolt or threaded rod.
- I. Provide insulation saddles as required herein.
- J. Hangers for horizontal hanging piping shall be as follows:

1.	Cast Iron Piping		
	PIPE SIZE		MSS TYPE
	4" and Larger		Adjustable Clevis, Type 1
	3" and Smaller		Split Ring, Type 7
2.	PVC Piping		
	PIPE SIZE		MSS TYPE
	2" and Larger		Adjustable Clevis, Type 7
	1-1/2" and Smaller		Split Ring, Type 6 or 12

- K. Horizontal hanging piping shall be supported as follows:

1.	Cast Iron Pipe:		
	PIPE SIZE	ROD DIA.	MAX. SPACING
	4" and Larger	1/2"	At Each Hub
	2" and 3"	3/8"	At Each Hub
2.	PVC Pipe:		
	PIPE SIZE	ROD DIA.	MAX. SPACING
	2-1/2" and Larger	10'	
	1-1/2" to 2"	3/8"	8'
	1" and Smaller	3/8"	6'

2.5 PIPE SLEEVES

- A. Furnish and set sleeves to accommodate pipes passing through foundations, walls, floors, furring and ceilings. Cooperate with other Contractors in setting all sleeves. Sleeves shall be full thickness of construction.
- B. Sleeves shall be large enough to permit free movement of pipe where expansion and contraction occur and to permit insulation to run continuous. Provide U.L. listed fire barrier seals in ALL floor, walls, ceilings, etc., and at all penetrations of fire rated construction. Fill annular space between pipe and sleeve with U. L. approved fire retarding packing, rated for 1 hours minimum. See fire stopping details on the drawings.
- C. Sleeves through exterior walls below grade, through foundation walls, shall be watertight construction. Use "Link-seal", compression type neoprene link seals installed in sleeve or core drilled hole.
- D. Sleeves for pipe through exterior masonry wall, floors on grade and through fire partitions shall be of galvanized steel pipe, at least two pipe sizes larger than pipe passing through. Sleeves through interior walls and floors, ceilings, furring and partitions shall be steel pipe. Sleeves for copper piping shall be copper pipe, Type "L", minimum 2 sizes larger or large enough to allow for insulation. Fasten sleeves securely in floors, walls and partitions.
- E. All sleeves in exposed locations shall be set so escutcheon plates specified shall cover entire sleeve.

2.6 ACCESS PANELS

- A. The extent of access requirements of mechanical work is indicated on the mechanical work drawings, or is defined by the provisions of this section and other Division 23 sections, and is hereby recognized to be dependent upon the nature of other adjoining work requiring access. The access units required are recognized to include: (1) those units directly indicated in the Contract Documents, (2) those units indirectly indicated in the Contract Documents by way of mechanical work located behind other construction or finishes, and requiring access, and (3) those additional units identified subsequently to the Contract Date, because of the actual manner in which mechanical work with required access is located in relation to other construction and finishes.
- B. Access panels shall be provided in ceilings, except in removable tile, and in walls to permit access to concealed valves, shock absorbers, trap primers, valves, etc. Valve panels shall be 12" by 12" minimum.
- C. The types of access units required as work of this section include removable cover plates and access doors, which may include units in walls, ceilings and floor surfaces. (Fire Rated, if required). Access panels for garage ceilings to be insulated.
- D. Provide access doors manufactured by one of the following, except as otherwise indicated, minimum size 12" x 12":
  - 1. Milcor Div.: Inryco Inc.
  - 2. Jay R. Smith Mfg. Company
  - 3. Zurn Industries, Inc.

2.7 FLOOR, WALL AND CEILING PLATES

- A. Escutcheon plates shall be installed on all exposed pipe passing through walls, floors or ceilings. Plates shall be as manufactured by Ritter Pattern and Casting Co., Bridgeport Brass Co., chrome-plated steel plates with set screw and concealed hinge. Plastic escutcheons are not approved.

PART 3 - EXECUTION

3.1 PIPING

A. General:

1. All pipes shall be round and straight, of required size. Cutting and threading shall be done with proper tools and pipes shall be reamed to full size after cutting.
2. Pipe sizes shown on the Drawings are nominal pipe sizes and not outside diameters unless specifically noted otherwise. Pipes shall be run substantially as indicated on the Drawings; however, Architect/Engineer reserves the right to require this Contractor to make minor changes in pipe locations where conflicts occur with other trades or existing conditions. Such changes shall be made without extra cost to Owner.
3. All pipes shall be run with proper grade to provide for easy draining and in group runs, where applicable, and in a neat and orderly manner, to the satisfaction of the Architect/Engineer.
4. Piping shall be installed with ample provisions for expansion and contraction to prevent injury to the same and to the building construction. Furnish expansion loops, where indicated or necessary, on long runs and anchors to permit proper loop deflection.
5. In general, unions are not indicated on the Drawings, but shall be provided in the following locations:
  - a. At pipe mounted equipment.
  - b. Connections to all pumps and other equipment requiring isolation for service or repairs.
  - c. Do not conceal unions in wall, partitions or ceilings except where access is available through removable ceiling tiles or access panels.
6. No piping shall be installed so as to cause an unusual noise from the flow therein under normal operation. Grade piping for complete drainage. Provide drain valves at all low points.
7. Ream or file each pipe cut to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageway. Caulking of threads will not be allowed on any piping.
8. Keep piping free of dirt, scale. Cover, cap or otherwise protect open ends of all piping during construction to prevent damage to threads or flanges and to prevent entry of foreign matter.
9. All piping through finished areas shall be carried in partitions, chases, or in recesses where provided in walls, through floors and in furred or hung ceilings. Run exposed pipes only where indicated or directed.
10. Where changes in pipe sizing occur, use only reducing eccentric type fittings, top of pipes flat. No bushings will be allowed.
11. No piping shall pass through ductwork, sheet metal work or structural steel unless approved by the Architect or Engineer.
12. Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specific coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.
13. Furnish and install 3/4" drain valves as specified, with threaded ends for hose connection to all low points in the mains and where indicated. Grade all supply and circulating piping for complete drainage of the system.

B. Piping System Joints: Provide joints of the type indicated in each piping system as follows:

1. Solder copper tube and fitting joints where indicated in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full

depth into fitting, and solder in a manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

2. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

### 3.2 HANGER, SUPPORTS AND ANCHORS

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including, but not limited to, proper placement of inserts, anchors and other building structural attachments.
- B. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms.
- C. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not support piping from other piping.
- D. Provide all necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- E. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.
- F. Install hangers and supports to allow controlled movement of hangers and supports which are copper plated.
- G. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes.
- I. Insulated Piping: Comply with the following installation requirements:
  1. Clamps: Attach clamps, including spacers to piping with clamps projecting through insulation.
  2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated install coated protective shields.
- J. Adjust hangers and supports as required under supports to bring piping to proper levels and pitch.

### 3.3 PIPE SLEEVES INSTALLATION

- A. Install pipe sleeves of the types indicated where piping passes through walls, floors, ceilings, roofs and structural members of the work. Provide sleeves of adequate size, accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in the sleeve, including allowance for thermal expansion. Where insulation includes a vapor barrier covering, provide sleeve with sufficient clearance for installation of vapor barrier, but not less than 2 pipe sizes larger than piping run. Install length of sleeve equal to thickness of construction penetrated. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and providing temporary closure to prevent concrete and other materials from entering pipe sleeves. Fire stop as detailed to maintain a minimum 2 hour rating.

- B. Provide "Link-seal" units at all pipe sleeves penetrating at exterior walls below grade.
- C. Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior, and elsewhere as indicated.

3.4 VALVES

- A. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
- B. Install valves with stems pointed up, in the vertical position where possible, but in no case with stems pointed downward from a horizontal plane.
- C. Where insulation is indicated, install valves, arranged in the proper manner to receive insulation, provide handle extensions as specified.

END OF SECTION 22 05 10

**SECTION 22 07 19 - PLUMBING SYSTEMS INSULATION**

**PART 1 - GENERAL**

**1.1 GENERAL REQUIREMENTS**

**A. Related Work Specified Elsewhere:**

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Plumbing Work passing through roof is specified in Division 7. Provide roof flashing boots for all plumbing roof penetrations for installation by the roofer.
5. Finish Painting is specified in Division 9.
6. Mechanical Work is specified in Division 23.
7. Electrical Work is specified in Division 26.

**B. Related Documents:**

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of Section 22 05 00 govern the work specified in this Section, where applicable.

**1.2 DESCRIPTION OF WORK**

**A. Work Included:** Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Domestic Water Piping Insulation.
2. Sanitary Vent Piping Insulation.
3. Condensate Piping Insulation.

**1.3 QUALITY ASSURANCE**

**A. Manufacturers:** Provide insulation products produced by one of the following for each type and temperature range of insulation:

1. Armacell
2. Rubatex
3. Owens-Corning

**B. Flame/Smoke Ratings:** Provide composite insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less and a smoke-developed rating of 50 or less, as tested by ASTM E84 (NFPA 255) method.

**C. All domestic hot and cold piping shall be installed with vapor barrier insulation materials, installed per the manufacturer's instructions to maintain a continuous vapor barrier. Vapor barrier shall be continuous at all specialties, hangers, valves and fittings. All fittings shall be mitered and sealed with a vapor barrier mastic.**



- D. Submit manufacturer's data on insulation indicating certification or other data as necessary to show compliance with these specifications and governing regulations. Include proof of compliance for tests of products for fire rating, corrosiveness, and compressive strength.
- E. Deliver insulation, coverings, cements, adhesives and coatings to the site in factory-fabricated containers with the manufacturer's stamp, or label, affixed showing fire hazard ratings of the products. Store insulation in original wrappings and protect from weather and construction traffic.
- F. All adhesives and sealants shall be Low VOC complying with LEED requirements.

**PART 2 - PRODUCTS**

**2.1 DOMESTIC WATER PIPE INSULATION**

- A. All domestic hot and cold water piping shall be insulated with Manville FLAMESAFE fiberglass pipe insulation, Owens-Corning fiberglass 25, or approved equal as specified below. The insulation shall have an average thermal conductivity not to exceed .25 BTU in. per sq. ft. per F. per hour at a mean temperature of 75 degrees F. Thickness of the insulation shall be as scheduled below. Jacket shall be ASJ. The insulations shall be applied over clean dry pipe with all joints firmly together. Longitudinal jacket laps and the butt strips shall be smoothly secured with self-sealing longitudinal lap joints
- B. Minimum insulation thickness shall be as follows:
  - 1. Domestic Water Piping:
    - a. Cold Water Piping: 1/2"
    - b. Hot Water and Hot Water Recirculation Piping:  
1 1/2" and Smaller: 1"
    - c. Hot Water and Hot Water Recirculation Piping:  
2" and Larger: 1 1/2"
  - 2. Vent Stacks:
    - a. All Sizes: 1/2"  
(for a minimum of 10'-0" below vent through roof penetrations)
  - 3. Condensate Drainage Piping: 1/2"
- C. All Sizes: All above grade cold water and condensate drain pipe and fittings shall be mitered with continuous vapor barrier mastic sealant. Valves shall have handle extensions insulated with closed cell neoprene tape wrap sealed with vapor barrier mastic and installed to prevent sweating. All strainers, drain valves and specialties to be insulated and sealed to prevent sweating. All insulation systems to run continuous through hangers and shall be installed with continuous vapor barrier.
- D. All seams and joints in the insulation system at fittings, valves, etc. shall be wrapped with insulated tape and sealed for continuous vapor barrier.
- E. Any PEX water piping shall be insulated with Armacell "FS Armaflex" closed cell elastomeric foam or approved equal as specified below. The insulation shall have an average thermal conductivity not to exceed .25 BTU in. per sq. ft. per F. per hour at a mean temperature of 75 degrees F. Thickness of the insulation shall be as scheduled below. The insulations shall be applied over clean dry pipe with all joints firmly together. Provide un-slit tubular form with no longitudinal joint. Butt strips shall be smoothly secured with sealed with factory adhesive.

- F. Air conditioning condensate drain piping shall be insulated with Armacell "FS Armaflex" closed cell elastomeric foam or approved equal as specified below. The insulation shall have an average thermal conductivity not to exceed .25 BTU in. per sq. ft. per F. per hour at a mean temperature of 75 degrees F. Pipe insulation shall be ½" Thickness. The insulations shall be applied over clean dry pipe with all joints firmly together. Provide un-slit tubular form with no longitudinal joint. Butt strips shall be smoothly secured with sealed with factory adhesive.

**PART 3 - EXECUTION**

**3.1 INSULATION**

- A. Insulation shall not be omitted on piping behind walls or in ceiling spaces. Covering shall be applied before finish work proceeds. Longitudinal seams on jackets shall be located so that they are not visible from the floor. Remove all stickers from covering.
- B. Insulation shall be applied over clean pipe with all joints butted firmly together and sealed with butt strips.
- C. Insulation shall run through all hangers and sleeves and have an 18-gauge sheet metal saddle equal to three (3) times the pipe diameter in length. All pipes 3" and larger in diameter shall be supported through insulation by fitting a protection saddle to the thickness of the insulation. Protection saddle shall be equal to Grinnell Co. Figure 160 to Figure 165A insulation shield protection saddles.
- D. All fittings, valves, etc. shall be insulated with the proper factory precut insulation. The ends of the insulation shall be tucked into the throat of the fitting and the edge adjacent to the pipe covering tufted and tucked into fully insulated pipe fitting. The one-piece PVC fitting cover shall then be secured by taping the ends to the adjacent pipe covering.
- E. Covering shall not be applied until all parts of the work have been tested by Contractor and approved by the Architect/Engineer.
- F. Where vapor barrier is called for, it shall be applied in accordance with the manufacturer's instructions to maintain the integrity of the vapor barrier.
- G. On exposed insulation, all longitudinal seams shall be kept at the top of the pipe and circumferential joints shall be kept to a minimum. Raw ends of insulation shall be concealed by neatly folding in the ends of the jackets. Fittings, valve bodies, and flanges shall be furnished with the same jacket materials used on adjoining insulation.

END OF SECTION 22 07 19

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## SECTION 22 11 16 - DOMESTIC WATER SYSTEMS

### PART 1 - GENERAL

#### 1.1 GENERAL REQUIREMENTS

##### A. Related Work Specified Elsewhere:

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Plumbing Work passing through roof is specified in Division 7. Provide roof flashing boots for all plumbing roof penetrations for installation by the roofer.
5. Finish Painting is specified in Division 9.
6. Mechanical Work is specified in Division 23.
7. Electrical Work is specified in Division 26.

##### B. Related Documents:

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of Section 22 05 00 govern the work specified in this Section, where applicable.

#### 1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:
- B. Domestic cold water system connecting each and every fixture, device, and item of equipment requiring cold water within the buildings, as well as all connections to new water service mains as indicated on Contract Drawings. The system shall be installed with all incidentals necessary for a complete operational system and shall include all piping, valves, stops, hydrants, meters, backflow preventers, gauges, structural support (hangers), and such other standard or specified accessories as are necessary for a complete approved system.
- C. Domestic hot water system connecting each and every fixture, device, and item of equipment requiring hot water within the building. The system shall be installed with all incidentals necessary for a complete operational system including, but not limited to water heater, pumps, controls, all piping, valves, stops, backflow preventers, vacuum breakers, structural support (hangers, etc.), and such other standard or specified accessories as are necessary for a complete approved system, including but not limited to:
1. Drain water heat reclaim system.
  2. Domestic water heaters and specialties as detailed.
  3. Insulation of domestic water piping as specified in Section 22 07 19.
  4. All labor, materials and equipment, material and/or services as required for new construction.
  5. Domestic water heater thermostatic mixing valves and controls.

1.3 CODES AND STANDARDS

- A. Domestic water systems shall comply with applicable National, State and Local Codes and Regulations, including but not limited to the Current New Hampshire Plumbing Code and amendments.

1.4 DOMESTIC WATER SERVICE

- A. Provide new domestic water service with PRV, meter and backflow preventer as detailed on the drawings.

1.5 STERILIZATION

- A. After completion all new domestic water piping and renovations to existing systems the systems shall be disinfected in accordance with the following:
  - 1. Piping systems shall be filled with water solution containing 50 PPM of available chlorine and allowed to stand for a minimum of six (6) hours.
  - 2. Following the allowed standing time, the system shall be drained and flushed with clean potable water until no chlorine remains in the water coming from the systems.
  - 3. After the systems have been flushed, drained and refilled, samples of the water will be taken to the State Health Department for a test. If it has been found that all impurities have not been removed, the above shall be repeated until the system is free from all impurities.

1.6 INSULATION

- A. Insulation of domestic cold, hot and recirculation water system piping is specified in Section 22 07 19, "Plumbing Systems Insulation".

1.7 CROSS CONNECTIONS

- A. No pipe shall be installed which will provide a cross or interconnection between the water systems and a polluted supply or drainage system. All submerged water connections with hose threaded outlets shall be protected by a suitable air gap, approved type backflow preventer or vacuum breaker.

1.8 SUBMITTALS

- A. Submit manufacturer's data on all water valves, specialties and equipment including rough-in drawings, templates, instructions and directions for connection with water piping and plumbing fixtures and equipment.
- B. Submit shop drawings on the following products:
  - 1. Water backflow preventer and PRVs.
  - 2. All piping, valves and valve accessories.
  - 3. Gauges, thermometers, strainers and all water specialties.
  - 4. Domestic water heaters.
  - 5. Water heaters.
  - 6. Thermostatic mixing valve assemblies.
  - 7. Pressure reducing valve.
  - 8. Backflow preventers and service equipment.

9. Non-freeze wall hydrants.
10. Access Panels.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Refer to Section 22 05 10 for piping, fittings, solder and associated piping accessories. All exposed domestic hot and cold water runs to plumbing fixtures and sinks shall be chrome plated.
- B. Unions
  1. Refer to Section 22 05 10 for unions.
  2. Provide di-electric unions where cooper tube is connected to ferrous pipe, refer to Section 22 05 10.

### 2.2 VALVES

- A. Refer to Section 22 05 10 for all valves.
- B. Refer to Section 22 05 10 for drain valves.

### 2.3 HANGERS

- A. Refer to Section 22 05 10 for hangers and supporting devices.
- B. Perforated strap iron hanger or Milford type copper plated steel hangers are not acceptable.

### 2.4 ACCESS PANELS

- A. Refer to Section 22 05 10 for access panels.
- B. Provide access panel doors for all concealed inaccessible valves, balancing fittings, in walls or ceilings shall be furnished by this Contractor and installed by tradesmen of wall or ceiling finish. Provide fire rated access panels when installed in rated assemblies, refer to Architectural Drawings for locations of fire rated assemblies.

### 2.5 WATER PIPING SPECIALTIES

- A. Provide the following piping specialties for installation in the water piping systems at the locations shown or as required by the project installation requirements.
  1. Main Water Service Backflow preventer: Model as specified on the drawings.
  2. Backflow Preventers: Model as specified on the drawings.
  3. Main Water Service Pressure reducing valves: Model as specified on the drawings.
  4. Pressure Gauges: Furnish and install pressure gauges as specified in Section 22 05 10, "Plumbing Basic Materials and Methods".
  5. Thermometers: Refer to Section 22 05 10, "Plumbing Basic Materials and Methods".
  6. Thermal Expansion Tanks: Provide thermal expansion tank, size and model as specified.
  7. Thermostatic mixing valves: As specified on the drawings.
  8. Thermometers: Refer to Section 22 05 10, "Plumbing Basic Materials and Methods".

9. Non-Freeze Wall Hydrants: Wall hydrant shall be Woodford Model B67, automatic draining with double check backflow preventer. ASSE Standard 1052 approved. 3/4" inlet and outlet. Hardened stainless steel operating stem and one-piece valve plunger to control both flow and drain functions. Exterior finish to be Chrome Plated, provide loose tee key with each hydrant.

## 2.6 DOMESTIC WATER HEATERS

- A. Furnish and install model equal to the quality and models as scheduled on the drawings.
- B. Provide thermostatic mixing valves, thermostatic expansion tanks, pressure and temperature relief valves and other valve and specialties as detailed.

## PART 3 - EXECUTION

### 3.1 INSTALLATION/APPLICATION/ERECTION/PIPING

- A. The arrangement of all piping indicated on the Drawings is generally diagrammatic. Conditions at the building shall determine the actual arrangement of runs, bends, offsets, etc.; conditions at the building shall be the determining factor for all measurements. The layout of all work shall be subject to the approval of the Architect/Engineer, but the Contractor shall be responsible for the necessary coordination of the work under this Contract. Wherever practicable, as determined by the Architect/Engineer, piping shall be installed concealed.
- B. Pipes passing through floors, concrete or masonry walls shall be centered in sleeves of pipe set in the concrete before pouring or grouted in masonry walls. Sleeves in the floor slab shall extend 2" above the finished floor. Sleeves shall be of the first possible pipe size larger than the pipe or insulated pipe overall diameter to yield a clearance of not less than 1/2" between the sleeve and the pipe or insulation. All insulated piping must be insulated continuously through pipe sleeves.
- C. All exposed piping to all fixtures, sinks and items of equipment shall be chrome plated. All connections to branches and fixtures shall be taken from top of mains.

### 3.2 VALVES

- A. Drains shall be installed at all low points of the water distribution systems. Stop valves shall be installed at each fixture and hydrant. Valves shall be so placed as to be readily accessible and shall not be installed with the stem inclined at more than 90 degrees from the upright position. The stuffing boxes of all valves shall be packed with new wicking and drips eliminated. All exposed piping must be chrome plated.

### 3.3 ADJUSTMENTS

- A. Adjust all pressure reducing valves, hot water tanks and fixture supply fittings for proper operation, and water temperature controllers for proper outlet temperatures.

3.4 TESTS

- A. Tests for Plumbing Systems: Water piping shall be tested by this Contractor and approved before acceptance. Equipment required for tests shall be furnished by the Contractor at no additional cost to the Owner. All tests shall be witnessed and approved by the Plumbing Inspector or his representative.
- B. Water System: When the roughing-in is complete, and before fixtures are set, the entire hot and cold water piping system shall be tested per Section 22 05 00, "Plumbing Basic Materials and Methods". Where a portion of the water piping system is to be concealed before completion, this portion shall be tested separately as specified for the entire system.
- C. Defective Work: If inspection or test indicate defects such defective work or material shall be replaced or repaired as necessary and inspection and tests repeated.

END OF SECTION 22 11 16



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**SECTION 22 4210 - PLUMBING WORK**

**PART 1 - GENERAL**

**1.1 GENERAL REQUIREMENTS**

**A. Related Work Specified Elsewhere:**

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Plumbing Work passing through roof is specified in Division 7. Provide roof flashing boots for all plumbing roof penetrations for installation by the roofer.
5. Finish Painting is specified in Division 9.
6. Mechanical Work is specified in Division 23.
7. Electrical Work is specified in Division 26.

**B. Related Documents:**

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of Section 22 0500 govern the work specified in this Section, where applicable.

**1.2 DESCRIPTION OF WORK**

**A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:**

1. Sanitary, waste, and vent systems within the buildings, including new sanitary waste and vent piping as shown on the drawings, installed with all incidentals necessary for a complete operational system. The system shall include all fixtures, piping, traps, flanges, seals, cleanouts, structural supports, fixtures, floor drains, and such other standard accessories as are necessary for a complete approved system.
2. Condensate Drainage Piping system for all air conditioning and cooling units.
3. All final connections to all items of equipment furnished by others requiring drain, waste and water services connections.

**1.3 CODES AND STANDARDS**

- A. ANSI Standards: Comply with applicable ANSI Standards pertaining to plumbing fixtures and systems.**
- B. ANSI Standards: Comply with ANSI A117.1 standard and latest edition of the American Disabilities Act (ADA) pertaining to installation of plumbing fixtures and trim for the disabled.**
- C. Codes: Comply with latest adopted edition of the 2018 International Plumbing Code incorporating the State of Vermont plumbing rules and all local codes and regulations.**

1.4 SUBMITTALS

- A. Submit manufacturer's data on plumbing fixtures and equipment including rough-in drawings, templates, instructions and directions for connections with water, waste, soil, and anchorages for plumbing fixtures.
- B. Submit shop drawings on the following products:
  - 1. Sanitary waste and vent piping and fittings.
  - 2. Floor drains.
  - 3. Floor receptors.
  - 4. Wall, floor and line cleanouts, including covers and access panels
  - 5. Plumbing fixtures and trim.

1.5 TESTS

- A. Hydrostatic tests of all soil, waste and vent Piping shall be performed in accordance with the Governing Regulations and in accordance with Section 22 05 00 Plumbing Basic Materials and Methods.

1.6 PLUMBING CROSS CONNECTIONS

- A. No pipe shall be installed which will provide a cross or interconnection between the water systems and a polluted supply or drainage system. All submerged water connections with hose threaded outlets shall be protected by a suitable air gap, approved type backflow preventer or vacuum breaker.

PART 2 - PRODUCTS

2.1 PLUMBING PIPING MATERIALS AND VALVES

- A. All soil, waste, and vent piping shall be as specified in Section 22 05 10, "Plumbing Basic Materials and Methods".
- B. Minimum vent terminal through roof shall be 4". Vent flashing at the roof shall be by the Roofing Contractor. Terminations shall be limited to 12" above finished roof to avoid frost closure.
- C. Unions:
  - 1. Unions shall be as specified in Section 22 05 10, "Plumbing Basic Materials and Methods".
  - 2. To prevent corrosion caused by dissimilar metals, this Contractor shall install dielectric unions or flanges where copper pipe or tubing is connected to ferrous pipe as specified in Section 22 05 10, "Plumbing Basic Materials and Methods".

2.2 HANGERS

- A. Provide hangers as specified in Section 22 05 10, "Plumbing Basic Materials and Methods".
- B. Hangers or supports shall be placed within 1' of each horizontal elbow. Vertical runs of pipe not over 5' in length shall be supported on hangers placed not over 12" from the elbow on the connecting horizontal run.
- C. Perforated strap iron hanger or Milford type copper plated steel hangers are not acceptable.

- D. Support pipes sufficiently clear of all part of structure to allow for full thickness of insulation.

2.3 TRAPS

- A. Traps at fixtures shall be as listed in the fixture schedule. Exposed traps shall be chrome plated and provided with bottom cleanout plug.
- B. Provide deep seal traps for all floor drains and floor receptors.
- C. Provide rubber Sure-Seal trap seals for all floor drains.

2.4 CLEANOUTS AND ACCESS PANELS

- A. Floor cleanouts shall be Zurn 1400 Series Level-trol Supreme cleanouts with polished bronze top. Cleanouts shall be set flush and level with top of finished floor surface.
- B. Wall cleanouts shall be brass, recessed head plugs with Zurn ZN-1443 access frame and cover.
- C. Access panel doors for all concealed inaccessible cleanouts in walls, or ceilings shall be furnished by this Contractor and installed by tradesmen of wall or ceiling finish. Access panels shall be type as specified in Section 22 05 10, "Plumbing Basic Materials and Methods".

2.5 DRAINS

- A. Floor Drains: Zurn Z-415, bronze type "B" strainer, 6" diameter with dura-coated cast iron body. Provide deep seal P-trap and trap primer connection for all floor drains.
- B. Floor receptors: shall be Zurn model Z-1902, size 12"x12" with 10" deep sump. Entire interior of unit shall be supplied with white acid resistant porcelain enamel interior and top, ABS anti-splash interior bottom dome strainer. Provide stainless steel grate, full or half grate as required for drainage application
- C. Indirect Drain Connection Recessed Wall Box: Oatey "MODA" secondary drain, recessed wall kit. Furnished with quarter-turn drainage funnel with umbrella, pre-installed inlet adaptor for condensate drainage or other auxiliary drainage piping. Drain kit shall provide 1" air gap with quarter turn plug for DWV testing, PVC construction, solvent weld joints meeting ASTM D2855 for PVC drainage systems.

2.6 PLUMBING FIXTURES

- A. General Requirements: References made herein to outfit numbers and figure numbers of plumbing fixtures are based on American Standard plate numbers to establish type and quality of materials. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock shield, wheel handle stops for supplies shall be furnished and installed with fixtures as specified below. Exposed traps and supply pipes for all fixtures and equipment shall be chrome plated and connected to the rough piping systems at the wall. Wall escutcheons shall be chromium plated or nickel-plated brass with polished, bright surfaces. Fixtures shall be Kohler Company, American Standard, and Eljer or approved equal.
- B. The Plumbing Contractor shall furnish all supports, brackets, bolts, etc. for proper installation of all fixtures requiring support. They shall be in accordance with the manufacturer's recommendations,

and, if necessary, shall be built into place as the building progresses. This Contractor shall be held responsible for the stability and proper support of all plumbing fixtures.

- C. All fixtures and fittings shall be made tamperproof. The use of screwdriver type adjustments is not acceptable, unless slots are capped or otherwise protected.

Kilton Building:

P-1 Water Closet: American Standard “Cadet PRO, Standard Height”, 15” high rim, Round bowl, 1.28 GPF, vitreous china, Model 215DA.104. Provide American Standard “Cadet” model 5503B slow-close round seat. Provide chrome plated wall supply with wheel handled stop and lead free braided stainless-steel water supply connectors.

P-1A Accessible Water Closet: American Standard “Cadet PRO, Right Height”, 16.5” high rim, Elongated bowl, 1.28 GPF, vitreous china, Model 215FC.104. Mount per ADA requirements. Provide American Standard “Cadet” model 5503A slow-close elongated seat. Provide chrome plated wall supply with wheel handled stop and lead free braided stainless-steel water supply connectors. Locate flush handle on accessible side of tank.

P-2 Accessible Drop-In Counter Lavatory: American Standard “Aqualyn”, Model 0476.028, countertop vitreous china. Faucet to be Symmons, Symmetrix model S-20-2-G, single handle, chrome plated brass faucet with pop-up drain. Provide brass chrome plated grid drain offset assembly, contractor shall install 0.5 GPM aerator. Provide chrome plated wall supply with wheel handled stops and lead free braided stainless steel water supply connectors. Provide chrome plated wall supply with wheel handled stops and lead free braided stainless steel water supply connectors. Mount per ADA requirements.

P-2A Accessible Wall Hung Lavatory: American Standard “Lucerne”, Model 0355.012, wall hung, vitreous china with Zurn Model Z-1253, adjustable concealed arm carrier. Faucet to be Symmons, Symmetrix model S-20-2-G, single handle, chrome plated brass faucet less pop-up drain. Provide brass chrome plated grid drain offset assembly, contractor shall install 0.5 GPM aerator. Provide chrome plated wall supply with wheel handled stops and lead free braided stainless steel water supply connectors. Provide Truebro “Handi-Lav” insulation kit on all exposed piping. Mount per ADA requirements.

P-2B Accessible Drop-In Counter Lavatory: Existing plumbing fixture to be replaced with new fixture revise existing rough-ins as required to replace fixture. Fixture to be American Standard “Aqualyn”, Model 0476.028, countertop vitreous china. Faucet to be Symmons, Symmetrix model S-20-2-G, single handle, chrome plated brass faucet with pop-up drain. Provide brass chrome plated grid drain offset assembly, contractor shall install 0.5 GPM aerator. Provide chrome plated wall supply with wheel handled stops and lead free braided stainless steel water supply connectors. Provide chrome plated wall supply with wheel handled stops and lead free braided stainless steel water supply connectors. Mount per ADA requirements.

P-3 Shower: Shower to be Oasis model SH3P-6032, 60” x 32” x 75-1/2” tall, three-piece fiberglass gel-coated shower compartment, provided with factory installed reinforced walls and integral 4” high dam. Provide Symmons “Temptrol” model C-96-1-VP-CHKS shower valve assembly, with pressure balanced mixing valve with integral service stops and 2.0 GPM shower head. Provide stainless steel curtain rod with weighted shower curtain. Contractor to grout base of shower per manufacturer’s instructions using multi-purpose thin set, to prevent deflection.

P-3A Accessible Shower: Shower to be BestBath model 4LRS3636B5T, 36” x 36” x 81-1/8” tall, barrier free four-piece gel coated fiberglass shower compartment with factory installed wood backing.

Furnish with factory supplied shower curtain rod, weighted shower curtain, integral 5/8" high dam, and t-shaped rubber water stopper kit. Provide Symmons "Temptrol" model C-96-1-VP-CHKS shower valve assembly, with pressure balanced mixing valve with integral service stops and 2.0 GPM shower head. Provide stainless steel curtain rod with weighted shower curtain. Contractor to grout base of shower per manufacturer's instructions using multi-purpose thin set, to prevent deflection.

P-3B Accessible Shower: Shower to be BestBath model 4LBS4836FB5T, 48" x 36" x 81-1/8" tall, barrier free four-piece gel coated fiberglass shower compartment with factory installed wood backing. Furnish with factory supplied shower curtain rod, weighted shower curtain, integral 5/8" high dam, and t-shaped rubber water stopper kit. Provide Symmons "Temptrol" model C-96-1-VP-CHKS shower valve assembly, with pressure balanced mixing valve with integral service stops and 2.0 GPM shower head. Provide stainless steel curtain rod with weighted shower curtain. Contractor to grout base of shower per manufacturer's instructions using multi-purpose thin set, to prevent deflection.

P-3C Accessible Shower: Shower to be BestBath model 4LRS4236B5B, 42" x 36" x 81-1/8" tall, barrier free four-piece gel coated fiberglass shower compartment with factory installed wood backing. Furnish with factory supplied shower curtain rod, weighted shower curtain, integral 5/8" high dam, and t-shaped rubber water stopper kit. Provide Symmons "Temptrol" model C-96-1-VP-CHKS shower valve assembly, with pressure balanced mixing valve with integral service stops and 2.0 GPM shower head. Provide stainless steel curtain rod with weighted shower curtain. Contractor to grout base of shower per manufacturer's instructions using multi-purpose thin set, to prevent deflection.

P-4 Tub/Shower: Oasis three-piece tub/shower compartment model TS3P-6032. 60" x 32" x 76-1/4" high, with factory reinforced walls, gelcoat surface, multi-level back wall shelving. Provide Symmons "Temptrol" model C-96-2-VP-CHKS tub/shower valve assembly, with pressure balanced mixing valve with integral service stops and 2.0 GPM shower head. Provide stainless steel curtain rod with weighted shower curtain. Contractor to grout base of shower per manufacturer's instructions using multi-purpose thin set, to prevent deflection.

P-5 Accessible Single Compartment Kitchen Sink: Elkay model LRAD312255, 31" x 22" x 5 1/2" deep, single bowl drop-in, 18 gauge type 304 single bowl kitchen sink. Provide drain air gap assembly for units with dishwashing machine. Provide basket strainer with 1 1/2" tailpiece. Faucet to be Symmons Origins model S-23-BH-1.5, single lever, 1.5 GPM aerator, chrome single lever handle type less hand spray. Provide chrome plated wall supplies with wheel handled stop. Provide Truebro "Handi-Lav" insulation kit on all exposed piping. Mount per ADA requirements.

P-5A Accessible Double Bowl Kitchen Sink: Elkay model LRAD331955, 33" x 19 1/2" x 5 1/2" deep, double bowl, 18 gauge type 304 self-rim single bowl kitchen sink drilled for listed faucet. Provide drain air gap assembly for units with dishwashing machine. Provide basket strainer with 1 1/2" tailpiece. Faucet to be Kohler model K-596, 1.5 GPM aerator, pull-down kitchen sink faucet. Provide chrome plated wall supplies with wheel handled stop. Provide chrome plated wall supplies with wheel handled stop. Provide Truebro "Handi-Lav" insulation kit on all exposed piping. Mount per ADA requirements.

P-6 Service Sink: Mustee model 63M, 24" x 24" x 10" high mop service basin with 3" integral molded drain. Provide Mustee faucet model 63.600 with factory supplied hose and hose bracket model 65.700. Provide Mustee mop hanger bracket model 65.600. Provide Duraguard wall guards against all wall surfaces model 67.2424.

P-7 Bi-Level Drinking Fountain: Elkay model EZSTLDDWSLK, ezH2O® Bottle Filling Station with Integral Fountain, Filtered Non-Refrigerated. Features shall include Hands-Free, Visual Filter Monitor, Filtered, Green Ticker, Laminar Flow, Antimicrobial finish, furnished with Flexi-Guard Safety bubbler. Electronic Bottle Filler Sensor with Mechanical Front Bubbler Button activation. Product shall be Wall Mount

with In-Wall Frame/Plate, for Indoor applications, serving 2 stations. Unit shall be certified to UL 399 and CAN/CSA C22.2 No. 120. Unit shall be lead-free design certified to NSF/ANSI 61 & 372 lead free and meeting Federal and State low-lead requirements, unit shall be installed for ADA compliance.

P-7A Bottle Filler: Elkay ezH2O® In-Wall Bottle Filling Station with Mounting Frame Filtered Non-Refrigerated Stainless. Features shall include Antimicrobial, Filtered, Green Ticker™, Hands Free, Laminar Flow, Real Drain, Visual Filter Monitor. Electronic Bottle Filler Sensor activation. Product shall be Wall Mount (Inwall Frame/Plate), for Indoor applications, serving 1 station(s). Unit shall be certified to UL 399 and CAN/CSA C22.2 No. 120.

P-8 Laundry Washer: Furnish and install Symmons LaundryMate Model W-602, wall box, with ½ inch soldered union connections, 2" standpipe connection, and service stops. Provide 36" high 2" standpipe.

P-9 Dishwasher: Provide drain air gap assembly, pipe to kitchen sink tailpiece, provide fixture stop and flexible water supply.

Welch Building:

P-1 Water Closet: American Standard "Cadet PRO, Standard Height", 15" high rim, Round bowl, 1.28 GPF, vitreous china, Model 215DA.104. Provide American Standard "Cadet" model 5503B slow-close round seat. Provide chrome plated wall supply with wheel handled stop and lead free braided stainless-steel water supply connectors.

P-1A Accessible Water Closet: American Standard "Cadet PRO, Right Height", 16.5" high rim, Elongated bowl, 1.28 GPF, vitreous china, Model 215FC.104. Mount per ADA requirements. Provide American Standard "Cadet" model 5503A slow-close elongated seat. Provide chrome plated wall supply with wheel handled stop and lead free braided stainless-steel water supply connectors. Locate flush handle on accessible side of tank.

P-2 Accessible Drop-In Counter Lavatory: American Standard "Aqualyn", Model 0476.028, countertop vitreous china. Faucet to be Symmons, Symmetrix model S-20-2-G, single handle, chrome plated brass faucet with pop-up drain. Provide brass chrome plated grid drain offset assembly, contractor shall install 0.5 GPM aerator. Provide chrome plated wall supply with wheel handled stops and lead free braided stainless steel water supply connectors. Provide chrome plated wall supply with wheel handled stops and lead free braided stainless steel water supply connectors. Mount per ADA requirements.

P-2A Accessible Wall Hung Lavatory: American Standard "Lucerne", Model 0355.012, wall hung, vitreous china with Zurn Model Z-1253, adjustable concealed arm carrier. Faucet to be Symmons, Symmetrix model S-20-2-G, single handle, chrome plated brass faucet less pop-up drain. Provide brass chrome plated grid drain offset assembly, contractor shall install 0.5 GPM aerator. Provide chrome plated wall supply with wheel handled stops and lead free braided stainless steel water supply connectors. Provide Truebro "Handi-Lav" insulation kit on all exposed piping. Mount per ADA requirements.

P-3 Shower: Shower to be Oasis model SH3P-6032, 60" x 32" x 75-1/2" tall, three-piece fiberglass gel-coated shower compartment, provide with factory installed reinforced walls and integral 4" high dam. Provide Symmons "Temptrol" model C-96-1-VP-CHKS shower valve assembly, with pressure balanced mixing valve with integral service stops and 2.0 GPM shower head. Provide stainless steel curtain rod with weighted shower curtain. Contractor to grout base of shower per manufacturer's instructions using multi-purpose thin set, to prevent deflection.

P-3A Accessible Shower: Shower to be BestBath model 5LRS6036FB75T, 60" x 36" x 81-1/4" tall, barrier free five-piece gel coated fiberglass shower compartment with factory installed wood backing. Furnish with factory supplied shower curtain rod, weighted shower curtain, integral 3/4" high dam, and t-shaped rubber water stopper kit. Provide Symmons "Temptrol" model C-96-1-VP-CHKS shower valve assembly, with pressure balanced mixing valve with integral service stops and 2.0 GPM shower head. Provide stainless steel curtain rod with weighted shower curtain. Contractor to grout base of shower per manufacturer's instructions using multi-purpose thin set, to prevent deflection.

P-3B Accessible Shower: Shower to be BestBath model 4LBS3636FB5T, 36" x 36" x 81-1/8" tall, barrier free four-piece gel coated fiberglass shower compartment with factory installed wood backing. Furnish with factory supplied shower curtain rod, weighted shower curtain, integral 5/8" high dam, and t-shaped rubber water stopper kit. Provide Symmons "Temptrol" model C-96-1-VP-CHKS shower valve assembly, with pressure balanced mixing valve with integral service stops and 2.0 GPM shower head. Provide stainless steel curtain rod with weighted shower curtain. Contractor to grout base of shower per manufacturer's instructions using multi-purpose thin set, to prevent deflection.

P-3C Accessible Shower: Shower to be BestBath model 4LRS4236B5B, 42" x 36" x 81-1/8" tall, barrier free four-piece gel coated fiberglass shower compartment with factory installed wood backing. Furnish with factory supplied shower curtain rod, weighted shower curtain, integral 5/8" high dam, and t-shaped rubber water stopper kit. Provide Symmons "Temptrol" model C-96-1-VP-CHKS shower valve assembly, with pressure balanced mixing valve with integral service stops and 2.0 GPM shower head. Provide stainless steel curtain rod with weighted shower curtain. Contractor to grout base of shower per manufacturer's instructions using multi-purpose thin set, to prevent deflection.

P-3D Shower: Shower to be Oasis model SH3P-4832, 48" x 32" x 75-1/4" tall, three-piece gel coated fiberglass shower compartment, provided with factory installed reinforced walls and integral 4" high dam. Provide Symmons "Temptrol" model C-96-1-VP-CHKS shower valve assembly, with pressure balanced mixing valve with integral service stops and 2.0 GPM shower head. Provide stainless steel curtain rod with weighted shower curtain. Contractor to grout base of shower per manufacturer's instructions using multi-purpose thin set, to prevent deflection.

P-4 Tub/Shower: Oasis three-piece tub/shower compartment model TS3P-6032. 60" x 32" x 76-1/4" high, with factory reinforced walls, gelcoat surface, multi-level back wall shelving. Provide Symmons "Temptrol" model C-96-2-VP-CHKS tub/shower valve assembly, with pressure balanced mixing valve with integral service stops and 2.0 GPM shower head. Provide stainless steel curtain rod with weighted shower curtain. Contractor to grout base of shower per manufacturer's instructions using multi-purpose thin set, to prevent deflection.

P-5 Accessible Single Compartment Kitchen Sink: Elkay model LRAD312255, 31" x 22" x 5 1/2" deep, single bowl drop-in, 18 gauge type 304 single bowl kitchen sink. Provide drain air gap assembly for units with dishwashing machine. Provide basket strainer with 1 1/2" tailpiece. Faucet to be Symmons Origins model S-23-BH-1.5, single lever, 1.5 gpm aerator, chrome single lever handle type less hand spray. Provide chrome plated wall supplies with wheel handled stop. Provide Truebro "Handi-Lav" insulation kit on all exposed piping. Mount per ADA requirements.

P-6 Service Sink: Mustee model 63M, 24" x 24" x 10" high mop service basin with 3" integral molded drain. Provide Mustee faucet model 63.600 with factory supplied hose and hose bracket model 65.700. Provide Mustee mop hanger bracket model 65.600. Provide Duraguard wall guards against all wall surfaces model 67.2424.

P-7 Bi-Level Drinking Fountain: Elkay model EZSTLDDWSLK, ezH2O® Bottle Filling Station with Integral Fountain, Filtered Non-Refrigerated. Features shall include Hands-Free, Visual Filter Monitor, Filtered, Green Ticker, Laminar Flow, Antimicrobial finish, furnished with Flexi-Guard Safety bubbler. Electronic



Bottle Filler Sensor with Mechanical Front Bubbler Button activation. Product shall be Wall Mount with In-Wall Frame/Plate, for Indoor applications, serving 2 stations. Unit shall be certified to UL 399 and CAN/CSA C22.2 No. 120. Unit shall be lead-free design certified to NSF/ANSI 61 & 372 lead free and meeting Federal and State low-lead requirements, unit shall be installed for ADA compliance.

P-7A Bottle Filler: Elkay ezH2O® In-Wall Bottle Filling Station with Mounting Frame Filtered Non-Refrigerated Stainless. Features shall include Antimicrobial, Filtered, Green Ticker™, Hands Free, Laminar Flow, Real Drain, Visual Filter Monitor. Electronic Bottle Filler Sensor activation. Product shall be Wall Mount (Inwall Frame/Plate), for Indoor applications, serving 1 station(s). Unit shall be certified to UL 399 and CAN/CSA C22.2 No. 120.

P-8 Laundry Washer: Furnish and install Symmons LaundryMate Model W-602, wall box, with ½ inch soldered union connections, 2" standpipe connection, and service stops. Provide 36" high 2" standpipe.

P-9 Dishwasher: Provide drain air gap assembly, pipe to kitchen sink tailpiece, provide fixture stop and flexible water supply.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION/APPLICATION/ERECTION/PIPING

- A. The arrangement of all piping indicated on the Drawings is generally diagrammatic. Conditions at the building shall determine the actual arrangement of runs, bends, offsets, etc.; conditions at the building shall be the determining factor for all measurements. The layout of all work shall be subject to the approval of the Architect/Engineer, but this Contractor shall be responsible for the necessary coordination of the work under this Contract. Wherever practicable, as determined by the Architect/Engineer, piping shall be installed concealed.
- B. Pipes passing through floors, concrete or masonry walls shall be centered in sleeves of pipe set in the concrete before pouring or grouted in masonry walls. Sleeves in the floor slab shall extend 2" above the finished floor. Sleeves shall be of the first possible pipe size larger than the pipe or insulated pipe overall diameter to yield a clearance of not less than 1/2" between the sleeve and the pipe of insulation.
- C. Soil, vent, drainage and waste lines shall be carefully graded, fitted and joined together. Joints shall be made gas and water tight. Horizontal drainage piping shall be installed in practical alignment within the building at a uniform grade of not less than 1/8" fall per foot and not more than 3/4" fall per foot. Pipe to be installed without undue strain or stresses and provisions made for expansion, contraction and structural settlement. Every fixture, floor drain and item of equipment shall be individually trapped and vented. Any soil and waste lines shall be provided with cleanouts at every change in direction and at the foot of vertical stacks. Changes in direction shall be made with Y's or 45 degree elbows. All offsets in vertical lines shall be made at a minimum angle of 45 degrees.

#### 3.2 FIXTURES

- A. Fixtures shall be the best product of the manufacturer and shall be without defects in construction or appearance and shall be set true and level, firmly supported in place without rocking or strain. Fixtures shall be adjusted for proper operation and shall be tested in the presence of the Architect/Engineer. All fixtures shall be thoroughly cleaned and all labels, stickers, and dirt marks shall be removed.

- B. The installation of all backing for plumbing fixtures and their accessories not affecting the structure shall be the work of this Contractor. Cutting and chasing which does not affect the structure shall also be the work of this Contractor.

**3.3 TESTS**

- A. Tests for Plumbing Systems: Soil, waste and vent piping shall be tested by the Contractor and approved before acceptance. Underground soil and waste piping shall be tested prior to backfilling. Equipment required for tests shall be furnished by this Contractor at no additional cost to the Owner. All tests shall be witnessed and approved by the Engineer and/or the Plumbing Inspector.
- B. Drainage and Venting System Piping: Shall be tested with water or air before the fixtures are installed in accordance with Section 22 05 10 – Plumbing Basic Materials and Methods.

**END OF SECTION 22 42 10**

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## SECTION 23 05 00 – MECHANICAL GENERAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 GENERAL REQUIREMENTS

A. Related Work Specified Elsewhere:

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Mechanical Work passing through membrane roof is specified in Division 7.
5. Finish Painting is specified in Division 9.
6. Plumbing Work is specified in Division 22.
7. Electrical Work is specified in Division 26.

B. Related Documents:

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of Section 23 05 00 govern the work specified in this Section, where applicable.

C. Reference to Drawings: All work to be performed is shown on Drawings listed at the end of this Section:

1. This Contractor shall refer to the Drawings for a full comprehension of the work to be done and for conditions affecting the location and placement of equipment and materials. These Drawings are intended to be supplementary to the specifications and any work indicated, mentioned, or implied in either is to be considered as specified by both. Should the character of the work herein contemplated or any matter pertaining thereto be not sufficiently explained in the specifications or drawings, this Contractor may apply to the Architect/ Engineer for further information and shall conform to such when given, as it may be consistent with the original intent. The Architect/Engineer reserves the right to make any reasonable changes in location prior to installation at no expense to the Owner. All lines are diagrammatic and exact locations are subject to the approval of the Architect/Engineer.
2. Before submitting his Bid, this Contractor shall visit the site with the plans and specifications and shall become thoroughly familiar with all conditions affecting his work since the Contractor will be held responsible for any assumption he may make in regard thereto.
3. This Contractor shall, at all times, have a foreman or superintendent on the project authorized to make decisions and receive instructions as if the Contractor himself were present. The foreman or superintendent shall not be removed or replaced without the express approval of the Architect/Engineer after construction work begins.
4. This Contractor shall employ competent and experienced workmen at a regular schedule in harmony with the other tradesmen on the job. The Contractor shall also exercise care and supervision of his employees in regard to proper and expeditious layout of his work.

- D. Extent: This specification applies to the KUA Kilton/Welch Dormitories and Faculty Residences. The Mechanical work required without limiting the generality thereof, includes the furnishing of all labor, materials, equipment, and services necessary for and reasonably incidental to the complete installation of all new VRF heat pump system, heat recovery units, electric radiation, electric duct coils, sheet metal ductwork, dryer vents, range exhaust ductwork, and accessories, insulation of ductwork and piping, automatic temperature control systems, installation of equipment, controls and accessories furnished by the owner or other suppliers including final connections, and all other materials, equipment, and labor necessary, whether or not such items are specifically indicated on the drawings or in the specifications, to complete all mechanical systems in all respects ready for continuous and trouble free operation.
- E. Intent: It is the intent of the Contract Documents to include all work and materials necessary for erecting complete, ready for continuous use all mechanical systems as shown on the accompanying drawings or as hereinafter described. These Drawings shall be taken in a sense as diagrammatic; sizes of pipes, ducts, etc., and methods of running them are shown, but it is not intended to show every offset and fitting nor every structural difficulty that will be encountered during the installation of the work.

## 1.2 ALTERNATES

- A. There are alternates which affect the fire protection work of this project.
- B. Refer to Division 1 specifications and bidder instructions for additional, related information.
- C. Alternates to the project which affect fire protection work are as follows:
  - 1. Welch Faculty Residence fit-up – Base bid, the faculty residence shall be constructed core and shell, no mechanical installed. Alternate will be full fit up of the Welch Faculty Residence and complete mechanical system.
  - 2. Kilton Faculty Residence A fit-up – Base bid, the faculty residence shall be constructed core and shell, no mechanical installed. Alternate will be full fit up of the Kilton Faculty Residence and complete mechanical system.
  - 3. Kilton Faculty Residence B fit-up – Base bid, the faculty residence shall be constructed core and shell, no mechanical installed. Alternate will be full fit up of the Kilton Faculty Residence and complete mechanical system.
  - 4. Existing Welch Renovation / Upgrades – Base bid, the existing faculty residence shall generally remain as it exists, with no mechanical modifications.

## 1.3 SUBMITTALS

- A. Refer to General Conditions for submittal provisions and procedures. Approval by the Architect/Engineer must be obtained prior to delivery of materials to the site.
- B. Shop Drawings: Within thirty (30) days of award of contract, the Mechanical Contractor shall submit, for approval, eight (8) copies of a complete list of manufacturer's shop drawings, detail prints, and data sheets for all shop drawings required.

- C. Product Data: Submit eight (8) copies of the manufacturer's specifications and installation instructions for each class of material or equipment and include other data as may be required to show compliance with these specifications.
- D. Test Reports: Submit certified test laboratory reports as necessary to show compliance with requirements.
- E. Colors: Colors of all materials shall be as selected by the Architect/ Engineer from the standard color ranges of each manufacturer from samples submitted as per above.

#### 1.4 QUALITY ASSURANCE

- A. Equality of Materials: Equality of materials or articles other than those named or described in this Section will be determined in accordance with the CONDITIONS OF THE CONTRACT.
- B. Tests: This Contractor agrees to accept as final the results of tests secured by a qualified testing laboratory engaged by the Owner. Tests will be conducted in accordance with the CONDITIONS OF THE CONTRACT.
- C. Products:
  - 1. All materials shall be new, full weight and first class in every respect, without defects, and designed to function properly in that portion of the work for which they are intended and with the same brand of manufacturers for each class of material or equipment.
  - 2. Equality of material or equipment other than those named or described in this Section will be determined in accordance with the revisions of the Contract and as specified further herein.

#### 1.5 REFERENCE STANDARDS

- A. The work shall be performed in such a manner as to conform to the Codes and Regulations governing such work, as may be required by Local and State Ordinances. This Contractor and his Subcontractors shall inform themselves of all State and Federal work safety rules and regulations, including the latest provisions of the Occupational Safety and Health Act of 1971 and all subsequent provisions. All workmen employed on the project shall be instructed in the requirements and shall observe same at all times.
- B. All work installed under these Plans and Specifications must be installed in strict accordance with the requirements of all local, state and other departments having jurisdiction, the utility companies, and with the requirements of the Underwriters' Laboratories, State Building Code, New Hampshire Department Public Safety, Fire Protection Regulations, N.F.P.A., Factory Mutual, and/or similar codes applied thereto. Where provisions of the Contract Documents conflict with any codes, or rules and regulations, the latter shall govern. Where the contract requirements are in excess of applicable codes, rules and regulations, the Contract provisions shall govern.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery: This Contractor shall provide for the delivery of all his materials and fixtures to the building site when required so as to carry on his work efficiently and to avoid delaying his work and that of other trades.
- B. Storage and Handling: This Contractor shall, at all times, fully protect his work and materials from injury or loss by others. Any injury or loss which may occur shall be made good without expense to the Owner. The Contractor shall be responsible for the proper protection of all his materials until the building is accepted by the Owner.

**1.7 PERMITS AND CODES**

- A. This Contractor shall obtain and pay for all licenses and permits and shall pay for all fees and charges for the connection to outside services and use of property other than the site of the work for storage of materials or other purposes.
- B. Work under this Contract shall be installed to comply strictly with latest applicable editions of International Building Code, including Supplements thereto and local amendments if any, current State of New Hampshire Guidelines for Energy Efficient Commercial Construction, Underwriters' Laboratories Regulations, National Fire Protection Association, ASHRAE Guide, SMACNA, ASME Code for Boiler and Unfired Pressure Vessels, Pipe, Fittings, Threads, Valves and Supporting Devices, National Electric Code and all codes, regulations, and requirements of all Municipal, State, Federal and other public or private authorities which have jurisdiction. In each case, codes, regulations and standards are minimum requirements and where the contract documents exceed these minimum conditions, the contractor shall comply with the more stringent requirements.

**1.8 MATERIALS AND SUBSTITUTIONS**

- A. All materials shall be new and conform to standards established in plans and specifications.
- B. All equipment shall be equal to the manufacturer and model numbers specified or noted on the Drawings. Engineer reserves the right to reject any substitute offered for items specified or noted on Drawings if found not equivalent to the specified manufacturer and model numbers.
- C. Substitute material and equipment, where requested or proposed by Contractor, shall be itemized and shall show cost to Owner whether it be an "addition" or "deduction" or "no change in cost" to the Base Bid price. It shall be held that no change in contract completion time will occur should Engineer elect to accept any alternate unless such time is specifically stated in the Contractor's Bid.
- D. Materials and equipment not approved shall not be used in construction.

**1.9 WORKMANSHIP**

- A. All work shall be executed in a workmanlike manner, presenting a neat, mechanical appearance when completed. Work not approved by Architect or Engineer shall be replaced by Contractor without additional charge to Owner. Align, level and adjust for satisfactory operation, install so that connecting

and disconnecting of piping and accessories for inspection, operation, maintenance and repair. Minor deviations from indicated arrangements may be made as approved.

- B. Piping and ductwork shall be run as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, neatly spaced. Check with other trades and prevent interference.
- C. Piping and ductwork shall be cut and fabricated accurately according to measurements taken at the building.
- D. This Contractor shall perform his work so as to cause no delay or interference with the progress of the general construction of the building and the work of the other trades or subcontractors. Materials and equipment shall be installed as soon as conditions or construction permit. Confer with all other trades or Subcontractors as to location of pipes, ducts, conduit and apparatus to avoid interference during installation.

#### 1.10 CLEANING AND ADJUSTMENT

- A. Each Contractor shall clear away all debris, surplus materials, etc., resulting from his work or operation, leaving the job and equipment furnished in a clean, first-class condition.
- B. Cleaning, Flushing and Inspecting: Clean, flush and inspect each piping system in accordance with requirements of Section 23 05 01, Mechanical Basic Materials and Methods Section.
- C. Clean ductwork internally, unit-by-unit as it is installed of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be insulated or painted, might interfere with or cause deterioration to final finish.
- D. Painting of materials and equipment furnished under the mechanical portion of the Contract will be done under the General Construction Contract. The Contractors shall, however, refinish and restore to the original condition and appearance, all equipment which has sustained damage to the manufacturer's enamel or paint finish. Materials and workmanship shall be equal to the requirements of the General Construction Contract.

#### 1.11 CERTIFICATES, DOCUMENTS AND INSTRUCTIONS

- A. Certificates and documents listed below for the convenience of Owner and Contractors are required under Mechanical and Electrical Section of the specifications. Previous to final payment, Contractor shall deliver copies of all such certificates and documents to the Architect for approval:
  - 1. All test data specified to be submitted under "TEST".
  - 2. Operating and Maintenance instructions for mechanical and electrical equipment and systems.
  - 3. All approved shop drawings.
  - 4. Temperature Control shop drawings with complete points list, logic diagrams and programming manuals.



**1.12 MISCELLANEOUS STEEL SUPPORTS**

- A. See drawings and schedules for equipment and materials that need to be fastened to and/or supported by the structure. Furnish and install all necessary anchor bolts, inserts, steel beams, bars, bearing and leveling plates and incidental items as may be needed to install the work. Items to be built into masonry and concrete must be furnished to the respective trade at the proper time to be built-in and shall include instructions and templates for their installation, unless it is explicitly shown or specified otherwise.

**1.13 REFERENCE STANDARDS AND INDUSTRY SPECIFICATIONS**

- A. Any material or operation specified by reference to published specifications of a manufacturer, a society, an association, a code or other published standard, shall comply with requirements of the listed document which is current on date of receipt of Bids. In case of a conflict between referenced documents, the one having more stringent requirements shall govern. Any Contractor, when requested, shall furnish a sworn affidavit from the manufacturer certifying that materials and/or manufactured products delivered to the job meet the requirements specified. However, such affidavit shall not relieve the Contractor from responsibility of complying with any added requirements of the project specifications.

1. International Building Code (IBC)
2. International Mechanical Code (IMC)
3. American Society of Mechanical Engineers (ASME)
4. Underwriters Laboratories (U.L.)
5. American National Standards Institute, Inc. (ANSI)
6. National Electrical Manufacturers Association (NEMA)
7. American Society of Testing Materials (ASTM)
8. National Electrical Code (NEC)
9. Air Moving and Conditioning Associations (AMCA)
10. Associated Air Balance Council (AABC)
11. National Fire Protection Association (NFPA)

**1.14 WARRANTY**

- A. The Contractor shall and hereby does warrant that all work executed and all mechanical equipment shall be free from defects of workmanship and materials for a period of one year from date of Substantial Completion of this work. The Contractor further agrees that he will, at his own expense, repair and replace all such defective work and all other work damaged thereby which becomes defective during the term of the Guarantee/Warranty.
- B. Use of Mechanical systems shall not constitute final acceptance and shall not constitute the start of the specified guarantee period.

**1.15 RECORD DRAWINGS**

- A. Refer to General Conditions for Record Drawings.

- B. Record Drawings shall reflect all changes from the Contract Drawings whether by change order or by field conditions. Principal dimensions of concealed work for control valves, and for piping installation including all major risers, valves, shut-offs and drains. Valve numbers shall be added as soon as established.
- C. Submit as-built drawings in hard copy and PDF format.

1.16 OPERATION AND MAINTENANCE MANUALS

- A. After all final tests and adjustments have been completed, fully instruct the proper Owner's representative in all details of operation for equipment installed. Supply qualified personnel to operate equipment for a minimum of 16 hours to assure that Owner's representative is properly qualified to take over operation and maintenance procedures. Also refer to Division 1 for related and additional information regarding project training requirements and Section 23 09 00 for control systems training requirements.
- B. Furnish the Architect/Engineer, for his approval, four copies of an Operation and Maintenance Manual. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the name and location of the equipment or the building, the name of the Contractor, and the Contract number. The manual shall have a table of contents with tab sheets placed before each section. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manuals shall be bound in hard binders or an approved equivalent.
- C. The manual shall include, at a minimum, the following information:
  - 1. Description of systems.
  - 2. Description of start-up, operation, and shutdown procedures for each item of equipment.
  - 3. Winter/summer changeover procedures.
  - 4. Schedule of adjustment, care, and routine maintenance for each item of equipment.
  - 5. Lubrication chart.
  - 6. Wiring and control diagrams with data to explain detailed operation and control of each item of equipment.
  - 7. Valve chart.
  - 8. List of recommended spare parts.
  - 9. Copies of all service contracts.
  - 10. Performance curves for pumps, fans, etc.
  - 11. List of all names, addresses, and phone numbers of all Subcontractors as well as the local representative for each item of equipment.
  - 12. Copies of all approved Shop Drawings.
  - 13. Copies of all Test Reports.
  - 14. All warranties for materials and equipment.
  - 15. All certificates of approval from applicable agencies for systems installed on this project.
  - 16. Final air and water flow balance report for all systems.
  - 17. Complete Equipment start-up reports prepared by factory authorized technicians.
  - 18. List of stock items and spare parts.
- D. See "Automatic Temperature Control", Section 23 09 00 for additional requirements.
- E. Submit O&M manuals in hard copy and PDF format.

1.17 PROTECTION

- A. Work shall include protecting the work and material of all other trades from damage by work or workmen, and shall include making good all damage thus caused.
- B. The Contractor shall be responsible for work and equipment until finally inspected, tested, and accepted; protect work against theft, injury, or damage; and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing or foreign material.
- C. Work includes receiving, unloading, un-crating, storing, protecting, setting in place, and connecting-up completely any equipment supplied. Work shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged by reason of mishandling or failure to protect on the part of the Mechanical Contractor.
- D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt, and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

1.18 IDENTIFICATION OF EQUIPMENT, DUCTWORK AND PIPING SYSTEMS

- A. All equipment shall be identified with a 3" wide by 1" high black phenolic nameplate with 1/2" high white letters. Nomenclature shall be required to accurately identify its respective equipment. Nameplates shall be secured to the equipment with suitable screws.
- B. All piping systems shall be identified with direction of flow arrows and printed color coded bands of plastic tape applied after finish painting of insulation and bare pipe. Letters to be not less than 1" high. Note color and working on valve tag chart. Pipe labels to be Seton Name Plate Corporation, Style B wrap around vinyl tape or other approved equal completely wrapped around the pipe and adhered to itself. Tape and label background colors shall conform to ASA recommendations.
- C. Piping shall be labeled as follows:
  - 1. Label all exposed piping which is not in the same room with major equipment at least once in each room through which the pipes pass, but never more than 15' between labels.
  - 2. Label all piping adjacent to major equipment and include zone or equipment numbers when there are two or more pieces of similar equipment.
  - 3. Direction of flow arrows shall be applied to piping adjacent to all labels and at each piece of equipment.
- D. All duct systems shall be identified with direction of flow arrows and red color coded letters to be not less than 2" high.
- E. Ducts shall be labeled as follows:
  - 1. Label all exposed ducts which is not in the same room with major equipment at least once in each room through which the duct pass, but never more than 15' between labels.
  - 2. Label all ducts adjacent to major equipment and include zone or equipment numbers when there are two or more pieces of similar equipment.

3. Direction of flow arrows shall be applied to ducts adjacent to all labels and at each piece of equipment.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 00

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## SECTION 23 05 10 – MECHANICAL BASIC MATERIALS AND METHODS

### PART 1 - GENERAL

#### 1.1 GENERAL REQUIREMENTS

##### A. Related Work Specified Elsewhere:

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Mechanical Work passing through membrane roof is specified in Division 7.
5. Finish Painting is specified in Division 9.
6. Plumbing Work is specified in Division 22.
7. Electrical Work is specified in Division 26.

##### B. Related Documents:

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of Section 23 05 00 govern the work specified in this Section, where applicable.

#### 1.2 GENERAL PROVISIONS

- A. Unless otherwise indicated, the materials to be furnished under this Contract shall be the standard products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design that complies with the Specification Requirements.
- B. Each major item of equipment shall have the manufacturer's name, address, serial and model numbers on a plate securely attached to the item. Each length of pipe fitting and device shall be labeled with the maker's name or symbol and weight or class of product.
- C. Belts, pulleys, chains, gears, couplings, projecting set-screws, keys and other rotating parts shall be located so that any person can come in close proximity and will be fully protected or properly guarded. High temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of a type specified in Section 23 07 19 Mechanical Systems Insulation.
- D. The Contractor shall obtain detailed information from the manufacturers of apparatus which he is to provide for the proper methods installation. He shall also obtain all information from the General Contractor and other subcontractors which may be necessary to facilitate his work and the completion of the whole project. The Contractor shall coordinate his work with the General Contractor. All work shall be installed in a manner and in locations approved by the Engineer.

- E. The Contractor shall keep himself fully informed as to the shape; size and position of all openings and foundations required for the specified apparatus and shall give full information to the General Contractor sufficiently in advance. Contractor shall furnish all supports herein specified, so that the General Contractor may build same in place. In the case of failure on the part of the Contractor to give proper information as noted above, contractor shall assume the cost of having the work done by others.
- F. All mechanical equipment shall be delivered to the site in the original sealed containers or packages bearing the manufacturer's name and brand designation. Piping shall be cleaned inside to remove dirt and loose scale, etc. Water piping shall be flushed out prior to testing of equipment. All open ends of pipe shall be capped or plugged during the construction period to prevent entrance of foreign materials. No pipe shall be installed outside of the building or in an exterior wall unless adequate provision is made to protect such pipe from freezing. Escutcheons shall be provided for all exposed piping passing through finished wall, floor or ceiling assemblies. Ductwork and casing shall be cleaned on the inside before fans are operated. After the equipment has been used for any purpose, such as adjusting, testing or temporary ventilation, filters shall be replaced with new filters. The General Contractor shall at all times protect his work, materials and equipment from any loss or damage.
- G. All equipment, ducts and piping shall be supported from the building structure. In general, all equipment, ducts and piping shall be installed concealed above ceilings or in walls, except as otherwise noted on the Drawings.
- H. Gas piping, valves, fittings including connections to gas water heaters.
- I. All motors, controls, and wiring provided from factory, shall be UL tested and labeled. All field installed 120 VAC control panels are also required to bare a UL label, for the tested assembly no field modifications to UL tested and labeled assemblies shall be permitted.

1.3 ELECTRICAL WORK

- A. Electrical equipment furnished by this Contractor and wired under Division 26, Electrical.
- B. Motors, magnetic starters with auxiliary contacts and other controls of devices for all packaged units.
- C. Disconnect switches when specified to be furnished with equipment.
- D. Line voltage relays and thermostats.
- E. Electrical equipment furnished, installed and wired by this Contractor:
- F. Low voltage controls, including relays.
- G. Interlocking and low voltage control wiring between controls, motor starters, relays, damper motors, and miscellaneous controls.
- H. All wiring shall be in accordance with Division 26, Electrical.
- I. Electrical equipment furnished, installed and wired under Division 26 work. The Electrical Contractor shall furnish and mount a magnetic motor starter for each motor where motors are not factory furnished in a package which includes motor controls.

J. Motors:

1. Motors shall be designed voltage and phase shown on the drawings, 60 Hz power, except as otherwise shown on the Drawings. Unless otherwise specified or shown on the Drawings, all motors shall have open drip-proof frames, Class F insulation and continuous duty classification based on a 40 degree C ambient temperature.
2. Motors shall be sized for the service intended and all motors shall have 1.15 service factor. The HP of the motors specified or shown on the Drawings is for guidance. The Contractor shall, at no extra charge to the Owner, make all necessary adjustments, including all electrical work for the equipment furnished by him. Prior to substantial completion, the Contractor shall verify all overloads for all motors furnished by him.
3. Motor Efficiencies for mechanical equipment shall meet or exceed the requirements of the New Hampshire Guidelines for Energy Efficient Commercial Construction.

1.4 TESTING OF SYSTEMS

A. General:

1. Each system shall be tested in accordance with the governing regulations and as specified herein. The Contractor shall furnish all certificates of compliance in triplicate to the Engineer.
2. Upon completion of fabrication and before enclosing, insulating or concealing in any way, all piping, mains and joints shall be tested for leaks at one and one-half their normal working pressures.
3. Provide test pumps, meters, gauges and other instruments and materials to test heating, ventilating, exhaust systems, as specified herein.
4. Before testing piping, remove or otherwise protect from damage all specialties and equipment not designed to withstand test pressures.
5. The Contractor shall notify the Engineer, in advance (min. 48 hours) of scheduled tests so that the Engineer may have a representative present during any or all tests. Repeat all tests, as required, to prove system tight and in perfect operating condition.
6. Patch holes in insulation, ductwork, and housings, which have been cut or drilled for test purposes in manner recommended by original installer.
7. All pipe lines shall be blown or flushed clean before tests are conducted.
8. Testing may be done in sections to facilitate construction.
9. The Contractor must accommodate his testing operation to the progress of the project as a whole and correct all defects appearing under tests and repeat the tests until all parts of the work have withstood them successfully. Screwed piping shall be made tight without caulking. When the work is presented for acceptance, all valve stem packing must be new and without leaks and all gauges must be in place and reading accurately. The Contractor shall make and remove all temporary piping connections required for the test and shall dispose of test water and all wastes after tests. He shall leave all work in good order, ready for full use.

B. Refrigeration Piping Systems:

1. Test and charge all piping systems. Testing shall be done prior to charging system. Fill system with 150 psig of nitrogen on low side and 300 psig on high side. Inspect all joints for four (4) hours, charge with dry nitrogen, evacuate for four (4) hours, and re-charge with nitrogen. Evacuate for four (4) hours prior to charging. Following approval of pipe test, charge system with R-410a refrigerant as recommended by the manufacturer. Check the entire system for leaks following charging. Allow to stand for 24 hours with system charged to test pressures. If there is



no change in gauge reading then system is acceptable. When testing is complete reduce pressure to proper operation pressures and install final charge. Remove control or relief valves which may be subject to damage during testing. Re-install following completion of testing and prior to final charging.

C. Hydronic System Piping:

1. Test Hydronic Systems piping hydraulically at 75 psi test pressure. Observe each test for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure. Minimum test period four (4) hours.
2. Additional Testing Requirements: If during the process of installing the specified systems the Engineer requires additional independent testing to confirm conformance with these specification the contractor shall be responsible for paying for and providing all testing deemed appropriate by the Engineer. Additional testing requirements will be invoked if there is a question relative to quality, workmanship or methods utilized during the installation of the work. The Engineer shall select and approve any or all independent testing agencies required for any and all such testing. The contractor shall also be responsible for all costs associated with removal and replacement of sections of the work required for testing.

1.5 OPERATING TESTS

- A. Conduct operational test of all systems, equipment devices and accessories.
- B. During operating test, arrange and pay for services of qualified and authorized representative of manufacturers of the equipment and controls, as directed by the Engineer. Included in this service will be instructions to the Owner or his representative of the operating and maintenance of respective equipment and controls.
- C. Adjust all automatic temperature controls for satisfactory operation cycles.
- D. Furnish diagrammatic layouts of automatic control systems and a set of printed instructions for their operation and maintenance to the Owner.
- E. Test and set safety and relief valves to specified relief pressure.
- F. Test and adjust all gauges, thermostats, meters and other equipment, after installation, to assure accurate operation.
- G. Adjustments and tests shall be repeated until systems operate in accordance with Contract requirements.
- H. Engineer shall inspect operating tests only after Contractor has completed them satisfactorily and requested inspection.

1.6 TEST DATA

- A. During operating tests, the Contractor shall record and forward to Engineer, in triplicate, in typewritten form, the following data:

1. Heat recovery unit supply and exhaust air flow rates.
2. RPM, BHP, of all fans and motor amperage readings.
3. System balancing report complete with air flow quantities.
4. Temperature rise through all heating equipment.
5. Final setting on all temperature controls and controllers.
6. All test data shall be identified in accordance with schedules on the Plans.

1.7 BALANCING

- A. The Contractor shall obtain the services of an independent Certified Testing and Balancing Agency approved by the Engineer that specializes in the testing and balancing of the Air Conditioning Systems. All tests and balancing procedures shall be in accordance with the SMACNA Manual for the Balancing and Adjustment of Air Distribution Systems and as specified herein.
- B. The Testing and Balancing Agency shall provide the following services for this project:
  1. Balance all new heat recovery units, fan coil units and pumps.
  2. Balance new systems piping to ensure delivery of air and heat water flow.
  3. Test the complete automatic control system for specified sequence of operation and temperature control, including safety and manual operating controls and sensing element locations. This work shall be performed in conjunction with the Control Contractor.
  4. All manually set balancing dampers and plainly mark their settings determined during the test and balancing procedure.
  5. The testing and balancing process shall be conducted on the systems and all installation conditions revealed by this process to be adversely affecting system performance and/or system balance from being obtained shall be listed and reported in the test data.
- C. The Contractor shall cooperate with the Testing and Balancing Agency as follows:
- D. Provide sufficient time before expected date of Substantial Completion of the Contract so that testing and balancing can be accomplished.
- E. The Contractor shall provide the Testing and Balancing Agency with a complete set of system design, drawings, specifications, approved shop drawings and equipment submittals including all manuals.
- F. The Contractor shall put all systems and equipment into full operation and shall continue the operation during each working day of testing and balancing.
- G. The Contractor shall verify in writing to the Engineer and the Testing and Balancing Agency that the installation of all components is complete before the testing and balancing process is started. Once the test and balancing procedure is started, it shall be continued until it is completed or until an installation incompleteness or required correction is discovered, at which time the test and balancing procedure shall be stopped. After the required changes are made to remedy the installation incompleteness or correction, the testing and balancing procedure shall be started again from the very beginning and not just completed from the point of stopping.
- H. The Contractor shall at no additional cost to the Owner have the required changes, corrections and additions made including changes to dampers, sheaves and belts which the balancing report indicates are necessary to obtain required system performance in accordance with Control Drawings and

specifications and shall obtain and pay the Testing and Balancing Agency to retest and re-balance systems after all corrections have been made.

- I. The installation shall not be considered complete until the final reports by the Testing and Balancing Agency indicate this to be fact in writing. Eight (8) copies of these reports shall be submitted to the Engineer for his final approval and acceptance.

## PART 2 - PRODUCTS

### 2.1 PIPE AND FITTINGS

- A. General: Provide pipe and fittings of the type grade, size and weight indicated for each piping system as shown on the Drawings and specified here herein.
- B. Hydronic System Piping
  1. Hydronic system piping shall be type "L" hard copper tubing with wrought copper fittings for solder fitting assembly. At the contractor's option Copper PRO-Press is an approved alternate to solder type fittings.
- C. Refrigeration Piping: Furnish and install all refrigeration piping, valves, strainers, solenoid valves, driers, sight glass, charging ports and accessories for a complete and operational system. Contractor must have a minimum of five years of experience in installation of refrigeration piping and accessories. The Contractor shall be responsible for handling of R-410a refrigerant. Only approved reclamation and evacuation equipment shall be used to avoid uncontrolled release of refrigerants. Refrigeration piping shall be hard temper copper, type ACR, using brazed joints. Test and purge system as specified. Following system installation charge all systems with R-410a refrigerant as specified.
- D. Condensate Drainage Piping: Schedule 40 PVC. Use drainage pattern fittings.
- E. Fittings:
  1. Cast bronze flanges where required shall be ANSI B-16.24, Class 300; raised ground face, bolts spot faced.
  2. Unions shall be of the same class and material as the pipe and fittings of the system in which they are installed.
  3. Dielectric unions: To prevent corrosion caused by dissimilar materials provide dielectric unions shall Watts Series 3000, with materials to match piping system. Flanged dielectric fittings shall be equal to Watts Series 3100 with materials to match piping system. Approved equals to the watts model specified shall be submitted for approval.

### 2.2 SPECIALTIES

- A. VRF Thermal expansion loops: Furnish and install refrigerant thermal expansion loops where specified and/or shown on the Drawings. Thermal expansion loops shall be MetraFlex "VRF Metraloop" flexible hose expansion loops, with two complete manufactured parallel sections of type 321 stainless steel corrugated hose and double layer of type 304 stainless steel. Provide pipe guides, pipe anchors and hangers and supports in accordance with manufacturer instructions.

2.3 VALVES

A. General:

1. Except as otherwise indicated, provide factory-fabricated valves of the type, body material and pressure class indicated. Where type or body material is not indicated, provide proper selection as determined by Installer for installation requirements, with pressure class selected from MSS or ANSI Standards based on the maximum pressure and temperature in the piping system. Except as otherwise indicated, provide valve size same as connecting pipe size.
2. For information only, submit two (2) copies of manufacturer's product data including dimensions, sizes, end connections, weights and installation instructions. Include instructions on repacking and repairing valves.
3. Valves shall be Jenkins, Walworth, Crane, Watts, Nibco-Scott or approved equal specified below. Valve type and numbers noted herein establish standard of type and quality. Valves 3" and larger shall have flanged ends; 2-1/2" and smaller have screwed ends for screwed piping and solder joint ends for copper tube piping. Provide valves for services listed below and of the following types.
4. Ball Valves: Ball valves for heating service shall be equal to Watts No. B-6000-SS, bronze body, 600 lb. W.O.G., stainless steel ball and stem, extended handle to accommodate insulation thickness, PTFE seat and seals, screwed ends or B-6001-SS sweat ends, virgin PTFE seats and seals. For gas service provide U.L. Approved model.
5. Check Valves: Watts series CVS, solder ends, series CV screwed ends, bronze body, 200 lb. W.O.G.
6. Drain Valves: Watts No. B-6000-SS, bronze body, stainless steel ball and stem, screwed ends, No. B-6001 sweat ends. Provide cap and chain, with 1/2" I.P.S. to 3/4" hose.
7. Balancing Valves: Tour and Anderson Model STAS with temperature/pressure readout ports, valve to be sized based on terminal flow rate. Handle shall be lockable type with memory stop.
8. Furnish and install strainers where specified and/or shown on the Drawings. Strainers shall be Wye Type, as manufactured by Armstrong or approved equal, designed for 125 psi, WSP minimum and shall be cast iron for 3" and larger, malleable iron or bronze with threaded ends for 2-1/2" and smaller. Mesh shall be stainless steel. Strainers shall be provided with blow-down valve, with cap and chain.

2.4 MECHANICAL SUPPORTING DEVICES

- A. General: All piping shall be rigidly supported from the building structure by means of approved hangers and supports. This Contractor shall furnish and install all necessary intermediate support steel and the proper hanging of all piping and equipment. Chains, strap, perforated bar or wire hangers shall not be permitted. Hangers for insulated piping shall be installed outside of insulation and provided with insulation protection saddles. Saddle shall be 12" long, 1/2 the circumference in width and 16 gauge for pipe 3" and larger and 6" long by 20 gauge for pipe 2-1/2" and smaller.
- B. All support components shall conform to Manufacturer's Standardization Society Specification SP-58. The hangers shall adequately support the piping system. They shall be located near or at changes in piping direction and at concentrated loads. They shall provide vertical adjustments to maintain pitch required for proper drainage and allow for expansion and contraction of the piping.
- C. Hangers shall be constructed of malleable or wrought iron. Where in contact with pipe hangers supporting copper pipe shall be copper-plated.

- D. Install all hangers straight and true, and in perfect alignment. Locate no hangers near couplings, fittings or bends in piping without making provisions for expansion.
- E. Where groups of three or more pipes occur, they may be supported with trapeze hangers, using two hangers as specified, with a capped pipe cross member.
- F. For vertical piping, support steel and copper pipe at every floor, with MSS Type 8 riser clamp.
- G. All pipe hangers shall be large enough to encompass the insulation, using a metal galvanized shield, so that vapor barrier jacket will not be broken or crushed.
- H. Inserts in the concrete slab shall be drilled in by the Contractor. Inserts driven in by explosive charges shall not be permitted. Inserts shall be of the type to receive a machine bolt or threaded rod.
- I. Provide insulation saddles as required herein. Hangers for horizontal hanging piping shall be as follows:
  - 1. Copper Piping

PIPE / SIZE	MSS TYPE
2" and Larger	Adjustable Clevis, Type 7
1-1/2" and Smaller	Split Ring, Type 6 or 12

J. Horizontal hanging piping shall be supported as follows:

Copper:	ROD DIA.	MAX. SPACING
2-1/2" and Larger	1/2"	12'
1-1/2" to 2"	3/8"	10'

2.5 PIPE SLEEVES

- A. Furnish and set sleeves to accommodate pipes passing through foundations, walls, floors, furring and ceilings. Cooperate with other Contractors in setting all sleeves. Sleeves shall be full thickness of construction.
- B. Sleeves shall be large enough to permit free movement of pipe where expansion and contraction occur and to permit insulation to run continuous. Provide U.L. listed fire barrier seals in floor, walls, ceilings, etc., at all penetrations of fire rated construction. Fill annular space between pipe and sleeve with U. L. approved fire retarding packing, rated for 1 hour minimum. See fire stopping details on the drawings.
- C. All sleeves in exposed locations shall be set so escutcheon plates specified shall cover entire sleeve.

2.6 SPECIALTIES

- A. Furnish and install pipe line type thermometers where specified and/or shown on the Drawings.
- B. Thermometers shall be H.O. Trerice Catalog No. A40507 or approved equal, with 9" scale, adjustable angle, and separable socket.

- C. Thermometers shall be installed so as to be easily read while standing on the floor.
- D. Furnish and install pressure gauges where specified and/or shown on the Drawings. Gauges shall be Trerice No. 450B with 4-1/2" dial, range as shown or approved equal to U.S. Gage or Crosby-Ashton. Each gauge shall be provided with a 1/4" ball valve gauge isolation valve. Gauges shall be installed so as to be easily read while standing on the floor. Provide pulsation dampener.

## 2.7 SUPPORTING DEVICES

- A. General: All piping shall be rigidly supported from the building structure by means of approved hangers and supports. This Contractor shall furnish and install all necessary intermediate support steel and the proper hanging of all piping and equipment. Chains, strap, perforated bar or wire hangers shall not be permitted. Hangers for insulated piping shall be installed outside of insulation and provided with insulation protection saddles. Saddle shall be 12" long, 1/2 the circumference in width and 16 gauge for pipe 3" and larger and 6" long by 20 gauge for pipe 2-1/2" and smaller.
- B. All support components shall conform to Manufacturer's Standardization Society Specification SP-58. The hangers shall adequately support the piping system. They shall be located near or at changes in piping direction and at concentrated loads. They shall provide vertical adjustments to maintain pitch required for proper drainage and allow for expansion and contraction of the piping.
- C. Hangers shall be constructed of malleable or wrought iron. Where in contact with pipe hangers supporting copper pipe shall be copper-plated.
- D. Install all hangers straight and true, and in perfect alignment. Locate no hangers near couplings, fittings or bends in piping without making provisions for expansion.
- E. Where groups of three or more pipes occur, they may be supported with trapeze hangers, using two hangers as specified, with a capped pipe cross member.
- F. For vertical piping, support steel and copper pipe at every floor, with MSS Type 8 riser clamp.
- G. All pipe hangers shall be large enough to encompass the insulation, using a metal galvanized shield, so that vapor barrier jacket will not be broken or crushed.
- H. Inserts in the concrete slab shall be drilled in by the Contractor. Inserts driven in by explosive charges shall not be permitted. Inserts shall be of the type to receive a machine bolt or threaded rod.
- I. Provide insulation saddles as required herein.
- J. Hangers for horizontal hanging piping shall be as follows:

### 1. Copper Piping

PIPE SIZE	MSS TYPE
2" and Larger	Adjustable Clevis, Type 7
1-1/2" and Smaller	Split Ring, Type 6 or 12

2. PVC Piping

PIPE SIZE	MSS TYPE
2" and Larger	Adjustable Clevis, Type 7
1-1/2" and Smaller	Split Ring, Type 6 or 12

A. Horizontal hanging piping shall be supported as follows:

3. Copper Pipe:

PIPE SIZE	ROD DIA.	MAX. SPACING
1-1/2" to 2"	3/8"	10'
1" and Smaller	3/8"	8'

4. PVC Pipe:

PIPE SIZE	ROD DIA.	MAX. SPACING
1-1/2" to 2"	3/8"	8'
1" and Smaller	3/8"	6'

2.8 PIPE SLEEVES

- A. Furnish and set sleeves to accommodate pipes passing through foundations, walls, floors, furring and ceilings. Cooperate with other Contractors in setting all sleeves. Sleeves shall be full thickness of construction.
- B. Sleeves shall be large enough to permit free movement of pipe where expansion and contraction occur and to permit insulation to run continuous. Provide U.L. listed fire barrier seals in floor, walls, ceilings, etc., at all penetrations of fire rated construction. Fill annular space between pipe and sleeve with U. L. approved fire retarding packing, rated for 1 hour minimum. See fire stopping details on the drawings.
- C. Sleeves through exterior walls below grade, through foundation walls, shall be watertight construction. Use "Link-seal", compression type neoprene link seals installed in sleeve or core drilled hole.
- D. Sleeves for steel pipe through exterior masonry wall, floors on grade and through fire partitions shall be of galvanized steel pipe, at least two pipe sizes larger than pipe passing through. Sleeves through interior walls and floors, ceilings, furring and partitions shall be steel pipe. Sleeves for copper piping shall be copper pipe, Type "L", minimum 2 sizes larger or large enough to allow for insulation. Fasten sleeves securely in floors, walls and partitions.
- E. All sleeves in exposed locations shall be set so escutcheon plates specified shall cover entire sleeve.

2.9 ACCESS PANELS

- A. The extent of access requirements of mechanical work is indicated on the mechanical work drawings, or is defined by the provisions of this section and other Division 23 sections, and is hereby recognized to be dependent upon the nature of other adjoining work requiring access. The access units required

are recognized to include: (1) those units directly indicated in the Contract Documents, (2) those units indirectly indicated in the Contract Documents by way of mechanical work located behind other construction or finishes, and requiring access, and (3) those additional units identified subsequently to the Contract Date, because of the actual manner in which mechanical work with required access is located in relation to other construction and finishes.

- B. Access panels shall be provided in ceilings, except in removable tile, and in walls to permit access to concealed valves, automatic damper operators, etc. Panels for fire dampers shall be of sufficient size to permit opening of the fire damper duct access door. Valve panels shall be 12" by 12" minimum.
- C. The types of access units required as work of this section include removable cover plates and access doors, which may include units in walls, ceilings and floor surfaces. (Fire Rated, if required).
- D. Provide access doors manufactured by one of the following, or approved equal, minimum size 12" x 12":
  - 1. Milcor Div.: Inryco Inc.
  - 2. Jay R. Smith Mfg. Company
  - 3. Zurn Industries, Inc.
  - 4. Or approved equal
- E. All access doors shall be keyed to allow use of one key.

#### 2.10 FLOOR, WALL AND CEILING PLATES

- A. Escutcheon plates shall be installed on all exposed pipe passing through walls, floors or ceilings. Plates shall be as manufactured by Ritter Pattern and Casting Co., Bridgeport Brass Co., or approved equal, chrome-plated steel plates with set screw and concealed hinge. Plastic escutcheons are not approved.

### PART 3 - EXECUTION

#### 3.1 PIPING

- A. General:
  - 1. All pipes shall be round and straight, of required size. Cutting and threading shall be done with proper tools and pipes shall be reamed to full size after cutting.
  - 2. Pipe sizes shown on the Drawings are nominal pipe sizes and not outside diameters unless specifically noted otherwise. Pipes shall be run substantially as indicated on the Drawings; however, Architect/Engineer reserves the right to require this Contractor to make minor changes in pipe locations where conflicts occur with other trades or existing conditions. Such changes shall be made without extra cost to Owner.
  - 3. All pipes shall be run with proper grade to provide for easy draining and in group runs, where applicable, and in a neat and orderly manner, to the satisfaction of the Architect/Engineer.
  - 4. Piping shall be installed with ample provisions for expansion and contraction to prevent injury to the same and to the building construction. Furnish expansion loops, where indicated or necessary, on long runs and anchors to permit proper loop deflection.
  - 5. In general, unions are not indicated on the Drawings, but shall be provided in the following



locations:

- a. At pipe mounted equipment, valves or coils
  - b. Connections to all radiation, coils, pumps and other equipment requiring isolation for service or repairs.
  - c. Do not conceal unions in wall, partitions or ceilings except where access is available through removable ceiling tiles or access panels.
6. No piping shall be installed so as to cause an unusual noise from the flow therein under normal operation. Grade piping for complete drainage. Provide drain valves at all low points.
  7. Ream or file each pipe cut to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageway. Caulking of threads will not be allowed on any piping.
  8. Keep piping free of dirt, scale. Cover, cap or otherwise protect open ends of all piping during construction to prevent damage to threads or flanges and to prevent entry of foreign matter.
  9. All piping through finished areas shall be carried in partitions, chases, or in recesses where provided in walls, through floors and in furred or hung ceilings. Run exposed pipes only where indicated or directed.
  10. Where changes in pipe sizing occur, use only reducing eccentric type fittings, top of pipes flat. No bushings will be allowed.
  11. No piping shall pass through ductwork, sheet metal work or structural steel unless approved by the Architect or Engineer.
  12. Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specific coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.
  13. Furnish and install 3/4" drain valves as specified, with threaded ends for hose connection to all low points in the mains and where indicated. Grade all supply and circulating piping for complete drainage of the system.
- B. Piping System Joints: Provide joints of the type indicated in each piping system as follows:
1. Solder copper tube and fitting joints where indicated in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in a manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
  2. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

### 3.2 HANGER, SUPPORTS AND ANCHORS

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including, but not limited to, proper placement of inserts, anchors and other building structural attachments.
- B. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms.

- C. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not support piping from other piping.
- D. Provide all necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes.
- G. Adjust hangers and supports as required under supports to bring piping to proper levels and pitch.

### 3.3 PIPE SLEEVES INSTALLATION

- A. Install pipe sleeves of the types indicated where piping passes through walls, floors, ceilings, roofs and structural members of the work. Provide sleeves of adequate size, accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in the sleeve, including allowance for thermal expansion. Install length of sleeve equal to thickness of construction penetrated. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and providing temporary closure to prevent concrete and other materials from entering pipe sleeves. All wall pipe penetrations shall be fire stopped for 1 Hour rating.
- B. Provide "Link-seal" units at all pipe sleeves penetrating at exterior walls below grade.
- C. Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior, and elsewhere as indicated.

### 3.4 VALVES

- A. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
- B. Install valves with stems pointed up, in the vertical position where possible, but in no case with stems pointed downward from a horizontal plane.
- C. Where insulation is indicated, install valves, arranged in the proper manner to receive insulation, provide handle extensions as specified.

END OF SECTION 23 05 10

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## SECTION 23 07 19 – MECHANICAL SYSTEMS INSULATION

### PART 1 - GENERAL

#### 1.1 GENERAL REQUIREMENTS

##### A. Related Work Specified Elsewhere:

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Mechanical Work passing through membrane roof is specified in Division 7.
5. Finish Painting is specified in Division 9.
6. Plumbing Work is specified in Division 22.
7. Electrical Work is specified in Division 26.

##### B. Related Documents:

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of Section 23 05 00 govern the work specified in this Section, where applicable.

#### 1.2 DESCRIPTION OF WORK

##### A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Hydronic Piping
2. Refrigeration Piping Insulation
3. Acoustical Duct Liner
4. Ductwork

#### 1.3 QUALITY ASSURANCE

##### A. Manufacturers: Provide insulation products produced by one of the following for each type and temperature range of insulation:

1. Armacell
2. Rubatex
3. Owens-Corning

##### B. Flame/Smoke Ratings: Provide composite insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less and a smoke-developed rating of 50 or less, as tested by ASTM E84 (NFPA 255) method.

- C. All new heating piping shall be installed with vapor barrier insulation materials, installed per the manufacturer's instructions to maintain a continuous vapor barrier. Insulation shall be continuous at all specialties, hangers, valves and fittings. All fittings shall be mitered and sealed with a sealing mastic.
- D. Submit manufacturer's data on insulation indicating certification or other data as necessary to show compliance with these specifications and governing regulations. Include proof of compliance for tests of products for fire rating, corrosiveness, and compressive strength.
- E. Deliver insulation, coverings, cements, adhesives and coatings to the site in factory-fabricated containers with the manufacturer's stamp, or label, affixed showing fire hazard ratings of the products. Store insulation in original wrappings and protect from weather and construction traffic.
- F. All adhesives and sealants shall be Low VOC complying with LEED requirements.

**PART 2 - PRODUCTS**

**2.1 PIPE INSULATION**

- A. Provide rigid preformed glass fiber insulation products or closed cell elastomeric piping insulation for piping systems as specified herein.
- B. All hydronic piping shall be insulated with Manville Micro-Lok fiberglass pipe insulation, Owens-Corning fiberglass 25, or approved equal as specified below. The insulation shall have an average thermal conductivity not to exceed .25 BTU in. per sq. ft. per F. per hour at a mean temperature of 75 degrees F. Thickness of the insulation shall be as scheduled below. The insulations shall be applied over clean dry pipe with all joints firmly together. Longitudinal jacket laps and the butt strips shall be smoothly secured with self-sealing longitudinal lap joints.
- C. Minimum insulation thickness shall be as follows:
  - 1. Hydronic Piping:
    - a. Mains and Branches Less than 1 1/2": 1 1/2"
    - b. Mains and Branches 1 1/2" and Larger: 2"
  - 2. Condensate Piping (All Sizes): 1/2"
- D. All other piping system fittings, valves etc. shall be insulated and finished with Zeston 200 insulated fitting covers, 10 mil. thickness.
- E. Refrigeration piping shall be insulated with 1" thick Armaflex insulation, seal all seams to maintain vapor barrier. Provide additional aluminum jacketing for exterior refrigerant piping. Secure to pipe with aluminum straps min. 2'-0" O.C.
- F. Condensate piping shall be insulated with 1/2" thick Armaflex insulation, seal all seams to maintain vapor barrier.

**2.2 DUCTWORK INSULATION**

- A. Ductwork shall be insulated with 1 1/2" thick, 1 pound density flexible duct insulation with factory applied duct wrap. Apply in accordance with manufacturer's instructions. Insulate the following duct systems:
1. All fan coil unit supply ductwork
  2. All heat recovery supply ductwork
  3. All fresh air intake ducts
  4. Dryer make-up air ductwork
  5. 4'-0" from exterior wall exhaust vent termination
  6. Ductwork shall not be run outside the building envelope unless approved by the Architect and Engineer.:
- B. Acoustical Insulation: Acoustical duct lining insulation shall be 1" thick, Armaflex closed cell neoprene liner (All duct sizes shall be increased accordingly.). Ducts requiring acoustical lining shall be lined throughout including all fittings, turns, elbows, etc. Provide liner for all rectangular supply and return ducts. All longitudinal joints in liner shall be coated. Provide metal nosings either Channel or Zee profile, securely installed over transversely oriented liner edges facing the air stream. Liner shall be installed with mechanical fastening devices that are spaced per SMACNA figure 2-19.

### 2.3 ACOUSTIC DUCTWORK LINER

- A. Acoustical Insulation: Acoustical duct lining insulation shall be 1" thick, Armaflex closed cell neoprene liner (All duct sizes shall be increased accordingly.). Ducts requiring acoustical lining shall be lined throughout including all fittings, turns, elbows, etc. Provide liner for main supply, return and exhaust ducts for a minimum of 15'-0" from fan, or as shown on the drawings. All longitudinal joints in liner shall be coated. Provide metal nosings either Channel or Zee profile, securely installed over transversely oriented liner edges facing the air stream. Liner shall be installed with mechanical fastening devices that are spaced per SMACNA figure 2-19.

## PART 3 - EXECUTION

### 3.1 INSULATION

- A. Insulation shall not be omitted on ducts and piping concealed behind walls or ceilings. Covering shall be applied before masonry proceeds. Longitudinal seams on jackets shall be located so that they are not visible from the floor. Remove all stickers from covering.
- B. Insulation shall be applied over clean pipe with all joints butted firmly together and sealed with butt strips.
- C. Insulation shall run through all hangers and sleeves and have an 18 gauge sheet metal saddle equal to three (3) times the pipe diameter in length. All pipes 3" and larger in diameter shall be supported through insulation by fitting a protection saddle to the thickness of the insulation. Protection saddle shall be equal to Grinnell Co. Figure 160 to Figure 165A insulation shield protection saddles.
- D. All fittings, valves, etc. shall be insulated with the proper factory pre-cut insulation.
- E. Covering shall not be applied until all parts of the work have been tested by Contractor and approved by the Architect/Engineer.

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- F. On exposed insulation, all longitudinal seams shall be kept at the top of the pipe and circumferential joints shall be kept to a minimum. Raw ends of insulation shall be concealed by neatly folding in the ends of the jackets. Fittings, valve bodies, and flanges shall be furnished with the same jacket materials used on adjoining insulation.

END OF SECTION 23 07 19

**SECTION 23 09 00 - TEMPERATURE CONTROLS**

**PART 1 - GENERAL**

**1.1 GENERAL REQUIREMENTS**

**A. Related Work Specified Elsewhere:**

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Mechanical Work passing through membrane roof is specified in Division 7.
5. Finish Painting is specified in Division 9.
6. Plumbing Work is specified in Division 22.
7. Electrical Work is specified in Division 26.

**B. Related Documents:**

1. The General Provisions of the Contract including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of Section 23 05 00 govern the work specified in this Section, where applicable.

**1.2 DESCRIPTION OF WORK**

**A. Work Included: Provide Labor, Material, and Equipment necessary to complete the work of this Section, including but not limited to the following:**

1. Automatic temperature control system installed with all incidentals necessary for a complete operational system. The system shall include all equipment necessary to provide fully automatic and manual control of all environmental systems as shown on Drawings and described in this specification. The system shall be complete in all respects, including space thermostats and/or space sensors, immersion thermostats, relays, provide all interlocks between all systems as required, and such other standard accessories and services necessary for a complete approved system.

**1.3 GENERAL REQUIREMENTS**

**A. This heat pump system is intended to have a standalone control system with factory web based headend to monitor and control the VRF heat pump system. T Provide controls for all other standalone equipment including domestic water heater pumps, heat recovery units and electric duct heating coils, and laundry make-up air unit.**

**B. The system shall be installed by competent mechanics regularly employed in the profession of temperature controls. Unless specified to the contrary, all equipment shall be fully proportioning. The control system shall be complete in all respects, including room sensors, immersion thermostats, relays, valves, cabinets, and other accessory equipment, and a complete system electric, and control wiring, all connected and properly integrated.**

**C. The temperature control system shall utilize electric for actuation.**



- D. All wiring, conduit, junction boxes, fittings, etc. necessary for the temperature control system shall be furnished and installed by this Contractor and shall conform to all standards and codes as described under Division 26, Electrical. All control circuits shall be 24 volts.
- E. Provide nameplates for all control devices. Devices on panels to have "Lamicoid" nameplates; isolated control valves, relays, etc. to be marked with stamped tape.

1.4 SCOPE

- A. This Contractor shall furnish and install all equipment, accessories, wiring, instruments, and piping required for a complete and functioning system.
  - 1. The system as specified shall control the HVAC equipment to maintain a comfortable environment in an energy efficient manner.
  - 2. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project. All components shall have been thoroughly tested and proven in actual use.
  - 3. This Contractor shall demonstrate that his capability to execute this Contract with evidence that he has actively engaged in the business of installing similar systems. Submit evidence that the manufacturer has factory supervised service facilities and competent technicians to service systems within the area.
  - 4. This Contractor shall provide a list of not less than five (5) similar projects which have building control systems as specified. These projects must be on-line and functional such that the Owner's representative would observe the control system in full operation.
- B. Wiring: All temperature control wiring will be installed and terminated by this Contractor. Control wiring shall be as follows:
  - 1. All circuits which are activated or de-activated by temperature control system components, such as, but not limited to, high and low limit protective devices.
  - 2. All circuits which activate or de-activate temperature control system components.
  - 3. All temperature control panel wiring to terminal strips and field wiring from terminal strips to field mounted devices.
  - 4. All wiring to the "Auto" side of hand-off auto switches on units being controlled by the ATC Contractor.
  - 5. Wiring of all electro-mechanical devices required to be located on or in temperature control panels.
- C. All wiring shall comply with National, State, and Local Electrical Codes. All power wiring will be installed and terminated by the Electrical Contractor. Power wiring shall be defined as follows:
  - 1. Wiring of all devices and circuits carrying 120 voltages or greater.
  - 2. Wiring of power feeds to all disconnects starters, and electric motors.
  - 3. Wiring of 120 VAC power feeds to all temperature control panels where required.
  - 4. Installation of and wiring of line power to fused disconnects for each pump.
  - 5. Power wiring to 120V single phase motors.
- D. Related Work - Work by Others:

1. Installation of Valves and Wells: Automatic temperature control valves and separable wells for immersion elements and couplings for flow and pressure switches furnished by the Control Manufacturer shall be installed by the Mechanical Contractor under the Control Manufacturer's supervision.
2. Painting: All finished painting required for control piping and equipment shall be done by the General Contractor.

#### 1.5 SHOP DRAWINGS

- A. This Contractor shall make a preliminary submittal of two (2) sets of drawings to the Engineer for review before any drawings are submitted through normal channels. On the preliminary submittals, the temperature control ranges, method of control and selection of control devices, description of operation, etc., will be reviewed and established.
- B. Separate submittals and cuts for dampers will be forwarded to this Contractor for his/her roughing and design information.
- C. The final shop drawings are to be complete with all devices identified by numbers and letters and those same identifying numbers used in the description of operation for positive ease in cross-referencing. Descriptive bulletins shall be included for all devices; these bulletins identified by the same key numbers and letters shall be used on the control layout. Description bulletins and/or control layout shall include data on sensitivity, pressure ranges, temperature ranges, means of adjustment, means of calibration, and all other data necessary for the Engineer to check use and function of each device for its intended application.
- D. At the completion of the job, final corrected "As-Installed" record shop drawings shall be furnished complete with all final pressure settings, temperature ranges, sample times, throttling ranges, and temperature control settings. In addition a print out of all control strategies which match the above drawings will be submitted as part of the "As-Installed" drawings. These are to be sent to the Engineer for review prior to submitting them to the Owner.

#### 1.6 GUARANTEE AND INSTRUCTION

- A. After completion of the control system installation, regulate and adjust all thermostats, control valves, damper motors, etc., and place them in complete operating condition subject to the approval of the Engineer. Instruct operating personnel, for winter cycle and for summer cycle.
- B. The control system herein specified shall be free from defects in workmanship and material under normal use and service. Any equipment proved to be defective in workmanship and material is to be adjusted, repaired, or replaced free of charge. Guarantee becomes effective from date of acceptance by the Owner. When the Owner receives beneficial use of the system or part, the guarantee shall start for that portion only, also subject to acceptance by the Owner.

### PART 2 - PRODUCTS

#### 2.1 HEAT PUMP SYSTEM CONTROL EQUIPMENT

- A. See Section 23 81 23 VRF System for factory control components, coordinate with installer for installation of factory controls.

2.2 CONTROL EQUIPMENT

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
    - a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
    - b. Line voltage units shall be UL recognized and CSA listed.
- B. Power Line Filtering.
1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
    - a. Dielectric strength of 1000 V minimum
    - b. Response time of 10 nanoseconds or less
    - c. Transverse mode noise attenuation of 65 dB or greater
    - d. Common mode noise attenuation of 150 dB or greater at 40–100 Hz
- C. Current Transmitters.
1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4–20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be  $\pm 1\%$  full-scale at 500 ohm maximum burden.
  2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
  3. Unit shall be split-core type for clamp-on installation on existing wiring.
- D. Current Transformers.
1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
  2. Transformers shall be available in various current ratios and shall be selected for  $\pm 1\%$  accuracy at 5 A full-scale output.
  3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.
- E. Current Switches.
1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

- F. Differential Pressure Switches. Differential pressure switches shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- G. Electronic Temperature Sensors: Vibration and corrosion resistant for wall, immersion, or duct mounting as required.
1. Resistance Temperature Detectors: Platinum, thermistor, or Balco
    - a. Accuracy: Plus or minus 0.2 percent at calibration point; thermistors shall have a maximum 5 year drift of no more than .225°F maximum error of no more than .36°F
    - b. Wire: Twisted, shielded-pair cable
    - c. Averaging Elements in Ducts: 60 inches, long, flexible for use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; 264 inches long, flexible for use where prone to temperature stratification or where ducts are larger than 16 sq. ft.; length as required.
    - d. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
    - e. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
    - f. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- H. Electronic Damper Actuators:
1. Electronic damper shall be spring return motor actuator type. A break mechanism shall prevent the return spring from driving the motor actuator toward its normal position unless the power is interrupted.
  2. The motor assembly shall include electric/electronic contacts, hardware, and brackets to allow proper motion and operation.
  3. The motor assembly shall include the necessary hardware and brackets to allow proper mounting and connection to a standard 1/2" diameter damper shaft or damper blade.
  4. Actuators shall be Belimo, or approved equal. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- I. Relays: Provide all necessary RIB relays for control of equipment. Relays shall include pilot light and manual HOA switch. Rating and voltage of relays shall be determined for each application. All relays shall be UL Listed.
- J. Electronic Discharge Air Temperature Sensors: Vibration and corrosion resistant for duct mounting as required.
1. Resistance Temperature Detectors: Platinum, thermistor, or Balco
    1. Accuracy: Plus or minus 0.2 percent at calibration point; thermistors shall have a maximum 5 year drift of no more than .225°F maximum error of no more than .36°F
    2. Wire: Twisted, shielded-pair cable
    3. Averaging Elements in Ducts: 60 inches, long, flexible for use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; 264 inches long, flexible for use where prone to temperature stratification or where ducts are larger than 16 sq. ft; length as required.
- K. Control Power Transformers: Furnish and install NEMA standard DC20-1992, 120VAC/24VAC transformers as required for control power.

L. Panels:

1. Control panels shall be fully enclosed NEMA 1 cabinets with all metal construction. Cabinets shall have hinged door with locking latch on cover plate. All cabinet locks shall be common keyed. Cabinets shall be finished with two coats of paint. Panels shall be wall mounted or freestanding as required.
2. All indicating devices manually adjusted during routine operations of systems shall be located on cabinet door. All control devices shall be located within the cabinet mounted to a sub-panel.

M. Smoke Detection:

1. For all air handling systems exceeding 1999 CFM, provide a smoke detector downstream of the supply fan, and a second detector in the return air stream.
2. The indication of smoke at either detector shall cause the supply and exhaust fans to stop and the outside intake and exhaust dampers to close through a second circuit. The detector installation and control action shall be strictly in accordance with Pamphlet 90A of the National Fire Protection Association. Test button and trip light shall be remote and located in visible areas, for testing and service.
3. Provide all required output relays and devices to interface with fire alarm system.

N. Dampers: Thermal Isolation Control Damper, equal to Greenheck Model: ICD-44, Leakage rating Dampers shall have a maximum leakage of 8 cfm/ sq. ft. @ 4 in. wg. or 3 cfm/ sq. ft. @ 1 in. wg. at -40°F. Tested in accordance with AMCA standard 500-D. Damper shall meet or exceed the IECC (International Energy Conservation Code) requirements for damper leakage ratings of 3 cfm per sq. ft. @ 1 in. wg. or 8 cfm per sq. ft. @ 4 in. wg. or less when integral to the building envelope. Dampers shall have a maximum differential pressure rating of 4 in. wg. Provide minimum ½ inch dia. plated steel Stainless steel axle shaft extended for exterior mounted actuator. Actuator to be Belimo model LF 24, spring return, 24V for fresh air intake Provide spring return, N.C. damper actuator, explosion proof housing, designed to close when exhaust fan is off.

O. Aquastats: Furnish and install Honeywell model L6006C1018 strap-on aquastat, 120 VAC, 8A, 120VAC.

2.3 LOCAL CONTROL PANELS

- A. All controllers, thermometers, relays, switches, etc. shall be mounted on an enclosed control panel, with hinged door. Temperature settings, adjustments, and calibrations shall be made at the system control panel. Relays and control switches shall be mounted in approved switch or junction boxes in mechanical rooms only.
- B. Details of the panels to be submitted for approval prior to fabrication. Locations of panels are to be convenient for adjustment and service. All manual switches and thermometers shall be flush mounted on the hinged door.
- C. All electrical devices within the panels shall be factory pre-wired to a numbered terminal strip. Wiring within the panel shall be in accordance with NEMA and U.L. Standards and shall meet all local codes.

2.4 SEQUENCES

- A. General: Provide automatic controls to accomplish the following control sequences. Refer to other Sections of this specification for Control equipment, devices and accessories furnished with equipment package. Provide controls for air source heat pumps, heat recovery units, make-up air units, exhaust fans, domestic hot water controls, and other controls as specified.
1. General System Description:
    - a. The buildings are served by a heat pump system consisting of ducted and ductless wall / ceiling mounted interior units and heat pump exterior units. Indoor fan coils shall be controlled by their individual thermostats.
    - b. Energy recovery units shall be provided with factory controls and shall run continuously to provide exhaust and fresh air to the building.
    - c. Provide controls for domestic hot water system.
    - d. Provide controls for the laundry dryer make-up air system.
    - e. Provide controls for the elevator hoistway ventilation system.
  2. Building Air Source Heat Pump System Controls:
    - a. Air source heat pump units shall be provided with individual thermostat controllers capable of controlling space heating and cooling set points. The heat pump systems shall be furnished with a touch screen centralized controller.
    - b. Each thermostat shall be programmed with an occupied/unoccupied set point. Fan coil units shall cycle and provide heating or cooling as required to maintain the zone set point.
    - c. Each System shall be programmed to operate in either a heating or cooling mode at the central controller, this shall be easily adjustable and accessible to the building operator for adjustment.
    - d. The thermostat jumper for each fan coil unit shall be cut so that fans run in an auto mode so that the fans cycle on call for heating or cooling.
  3. Typical Faculty Residence Heat Recovery Unit Control Sequence
    - a. The heat recovery unit shall be sequenced to run continuously.
    - b. If room CO2 sensor exceeds 900 PPM the unit shall run, if room CO2 is below 800 PPM the unit shall shutdown.
    - c. When unit is called to run the outdoor and exhaust air dampers shall open and both the supply and exhaust fans shall run. When unit is commanded to stop both fans shall stop and outdoor and exhaust air dampers shall close.
    - d. Each Unit is provided with an electric duct coil which shall be modulated using an SCR discharge air control system thermostat to maintain a constant discharge air set point of 65 deg. F. adjustable.
  4. Typical Dorm Heat Recovery Unit Control Sequence:
    - a. The Heat Recovery Units provide fresh air and exhaust for the each zone and shall run when commanded to run by the controls specified. Provide start-stop, status and alarm control of the factory supplied fan VFD's. using the VRF control system.
    - b. Unit supply and exhaust fans shall be provided with factory installed ECM motors.
    - c. When called to run the supply and exhaust fans shall run continuously with outdoor air and exhaust air dampers open. A discharge air thermostat shall modulate LEV refrigeration coil

controls to maintain constant discharge air temperature of 70 deg. F (adjustable) leaving the duct coil in the winter and 55 deg. F in the summer.

- d. When called to stop fans shall remain off, the coil valve shall be off.
  - e. Filter Status: Provide differential air pressure switch for filter bank to signal when unit filters require service.
5. Domestic Hot Water Heater Controls:
- a. Provide all required controls to allow heat pumps and hydronic pumps to heat hot water using indirect water heater coils. The closed loop pumps shall be wired and controlled by respective water heater aquastat to maintain the setpoint.
  - b. When called to run the controls for the heat pump shall be energized and shall only run if flow switch is activated.
6. Elevator Hoistway Temperature Controls:
- a. A room cooling thermostat shall start exhaust fan when room is above 80 Deg. F.
7. Dryer Make-up Air system:
- a. Provide interlock sensor for each dryer, the activation of the dryer shall energized a 24VAC normally closed dryer intake damper to provide make-up air.
  - b. Unit shall be provided with an electric duct coil which shall be modulated using an SCR discharge air control system thermostat to maintain a constant discharge air set point of 65 deg. F. adjustable.
8. Room Temperature Sensors:
- a. Furnish and install remote sensors located in public areas.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that duct, pipe, and equipment mounted devices and wiring are installed before proceeding with installation.

#### 3.2 INSTALLATION

- A. On completion of the job, this Contractor shall completely adjust, ready for use, all thermostats, valves, damper motors, and relays provided under his contract and be present for functional tests of the systems. This Contractor shall provide a complete instruction manual covering the function and operation of all control components on the job which shall include a trouble-shooting and operating procedure. This manual shall be furnished to the Owner and shall show the total integrated control system. A competent technician shall be provided for instruction purposes. This Contractor shall furnish framed schematic control diagrams to be located in their appropriate Mechanical Room adjacent to the Temperature Control Panel. Refer to Mechanical Section for "Testing, Adjusting, and Balancing", and cooperate with other Contractors in this phase of the work.
- B. Before the Engineer is asked to supervise and/or witness the adjustments called for in this specification, the Control Contractor through the Mechanical Contractor shall state in writing that the entire system is

complete, that the controls have been calibrated and that the controlled devices and/or equipment have been physically inspected and checked to assure that these terminal devices are in fact under proper control and working smoothly over their entire range of operation.

- C. Control system shall neither be considered complete nor acceptable until all conditions of the sequence of operation have been attached and all temperatures are maintained within specified limits at all operating conditions.
- D. Provide coordination with equipment manufacturer, Mechanical Contractor and Electrical Contractor for proper sequence of operation and for interlock required with smoke and fire alarm systems, etc.
- E. Installation shall include the following:
  - 1. Install all equipment level and plumb.
  - 2. Connect and configure equipment to achieve sequence of operation specified.
  - 3. Verify location of thermostats, and other exposed control sensors with plans and room details before installation. **Locate all 48 inches above the floor to the centerline.**
  - 4. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
  - 5. Install automatic dampers according to Division 23.
  - 6. Install damper actuators on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
  - 7. Install labels and nameplates to identify control components according to Division 23 Section "Mechanical Basic Mechanical Materials and Methods."
  - 8. Install labels and nameplates to identify control components according to Division 23 Section "Mechanical General Requirements."
  - 9. Install duct volume-control dampers.
  - 10. Install electronic and fiber-optic cables required for complete system operation.

### 3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to NEC.
- B. Install building wire and cable according to NEC.
- C. Install signal and communication cable according to NEC. Conceal cable, except in mechanical rooms and areas where other conduit and piping are required and as follows:
  - 1. Install exposed cable in conduit.
  - 2. Install concealed cable in raceway.
  - 3. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
  - 4. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
  - 5. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.



- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
  - 1. Install piping adjacent to machine to allow service and maintenance.
- B. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
  - 3. Calibration and test electric/electronic thermostats by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Replace damaged or malfunctioning controls and equipment.
  - 1. Start, test, and adjust control systems.
    - a. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
    - b. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

### 3.6 FOLLOW-UP ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three, separate, 8 hour, Project site visits, when requested by Owner or the Engineer, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
  - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
  - 2. Provide operator training on data display, alarm and status descriptors. Include a minimum of 8 hours dedicated instructor time on-site.

3. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
4. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
5. Schedule training with Owner, through Engineer, with at least seven days advance notice.

### 3.8 TRAINING

- A. Provide a minimum of 8 hours of on-site or classroom training throughout the contract period for personnel designated by the Owner. Each session shall be a minimum of four hours in length and must be coordinated with the building Owner. Train the designated staff of Owners Representative and Owner to enable them to:
  1. Proficiently operate the system
  2. Understand control system architecture and configuration
  3. Adjust and change system set points, time schedules, and holiday schedules
  4. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
  5. Understand system drawings, and Operation and Maintenance manual
  6. Understand the job layout and location of control components
  7. Access data from controllers.

### 3.9 PROJECT COMPLETION REQUIREMENTS

- A. On completion of the job, this Contractor shall completely adjust, ready for use, all thermostats, valves, damper motors, and relays provided under his contract and be present for functional tests of the systems. This Contractor shall provide a complete instruction manual covering the function and operation of all control components on the job which shall include a trouble-shooting and operating procedure. This manual shall be furnished to the Owner and shall show the total integrated control system. A competent technician shall be provided for instruction purposes. This Contractor shall furnish framed schematic control diagrams to be located in their appropriate Mechanical Room adjacent to the Temperature Control Panel. Refer to Mechanical Section for "Testing, Adjusting, and Balancing", and cooperate with other Contractors in this phase of the work.
- B. Before the Engineer is asked to supervise and/or witness the adjustments called for in this specification, the Control Contractor through the Mechanical Contractor shall state in writing that the entire system is complete, that the controls have been calibrated and that the controlled devices and/or equipment have been physically inspected and checked to assure that these terminal devices are in fact under proper control and working smoothly over their entire range of operation.
- C. Control system shall neither be considered complete nor acceptable until all conditions of the sequence of operation have been attached and all temperatures are maintained within specified limits at all operating conditions.

### 3.10 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test each point through its full operating range to verify that safety and operating control set points are as required.
4. Test each system for compliance with sequence of operation.

C. Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check temperature instruments and material and length of sensing elements.
4. Check system as follows:
  - a. Verify that wires at control panels are tagged with their service designation and approved tagging system.
  - b. Verify that controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.11 GUARANTEE AND INSTRUCTION

- A. After completion of the control system installation, regulate and adjust all thermostats, control valves, damper motors, etc., and place them in complete operating condition subject to the approval of the Engineer. Instruct operating personnel, for winter cycle and for summer cycle.
- B. The control system herein specified shall be free from defects in workmanship and material under normal use and service. Any equipment proved to be defective in workmanship and material is to be adjusted, repaired, or replaced free of charge for One Year after final acceptance of the system. Guarantee becomes effective from date of acceptance by the Owner. When the Owner receives beneficial use of the system or part, the guarantee shall start for that portion only, also subject to acceptance by the Owner.

END OF SECTION 23 09 00

## SECTION 23 21 13 – HEATING SYSTEM EQUIPMENT

### PART 1 - GENERAL

#### 1.1 GENERAL REQUIREMENTS

##### A. Related Work Specified Elsewhere:

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Mechanical Work passing through roof is specified in Division 7. Provide roof flashing boots for all mechanical roof penetrations for installation by the roofer.
5. Finish Painting is specified in Division 9.
6. Plumbing Work is specified in Division 22.
7. Electrical Work is specified in Division 26.

##### B. Related Documents:

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of Section 23 0500 govern the work specified in this Section, where applicable.

#### 1.2 DESCRIPTION OF WORK

##### A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Hydronic water piping systems installed with all incidentals necessary for a complete operational system. The system shall include all hydronic supply and return piping, valves, strainers, pumps, specialties, glycol injection pump and tank, air separators, expansion tank, air vents, etc., pipe fittings, hangers and supports, anchors and guides.
2. Electric duct coils,
3. Electric radiation.
4. Electric wall heaters

#### 1.3 CODES AND STANDARDS

##### A. U.L. and NEMA Compliance: Provide electric motors and components which are listed and labeled by Underwriter's Laboratories and comply with NEMA Standards.

#### 1.4 SUBMITTALS

##### A. Product Data: Submit manufacturer's technical product data and installation instructions for hydronic heating equipment materials, specialties and accessory products. Include technical data, installation instructions, size capacity and use location.

- B. Maintenance Data: Submit maintenance data and parts lists for hydronic specialties, equipment and products. Include with this data, product data, shop drawings and record drawings in maintenance manual.
- C. Provide submittals for the following equipment and accessories:
  - 1. Piping, valves, specialties and accessories
  - 2. Thermal expansion tanks and air separators
  - 3. Glycol Injection Pump and Tank
  - 4. Pumps
  - 5. Electric duct coils,
  - 6. Electric radiation.
  - 7. Electric wall heaters
  - 8. Thermometers and gauges.

## PART 2 -PRODUCTS

### 2.1 PIPING MATERIALS AND PRODUCTS

- A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ASME B31.9 Code for Building Services Piping where applicable, base pressure rating on hydronic piping systems maximum design pressures. Provide sizes and types matching piping and equipment connections.
- B. Refer to Section 23 05 10 for pipe, tubing, fittings and accessories for this project.
- C. Provide fittings of materials which match pipe materials used in hydronic piping systems. Where more than one type of materials or products are indicated, selection is Installer's option. Dissimilar materials shall be separated with dielectric unions.
- D. Provide pipes and pipe fittings complying with Section 23 05 10, Basic Materials and Methods Section "Pipes and Pipe Fittings", joining materials and installation procedures and methods.
- E. Provide piping specialties complying with Section 23 05 10, Mechanical Basic Materials and Methods Section "Valves" and Specialties.
- F. Pitch all hydronic system piping water piping mains up in direction of flow 1/8" in 10 feet. Install manual air vents at all high points. Use eccentric reducers, tops flat, on all hot water heating water piping mains and branches.
- G. Provide supports and anchors complying with Section 23 05 10, Mechanical Basic Materials and Methods Section "Mechanical Supporting Devices".
- H. Provide identification complying with Section 23 05 10 Mechanical Basic Materials and Methods Section "Mechanical Identification".

2.2 FLEXIBLE CONNECTIONS (PIPING)

- A. Flexible connectors for use at equipment connections shall have corrugated bronze core with high tensile bronze braided shroud, factory assembled and minimum design working pressure of 150 psig and shall be Anaconda, Flexonics, or Kelfex. Equal to Keflex KFCB-MPT-CTF-FLG. to suit piping system assembly or equipment connections.
- B. Provide 12" long flexible pipe connectors at locations shown on the drawings.

2.3 STRAINERS

- A. Provide pipe line strainers as specified in Section 23 0510, Mechanical Basic Materials and Methods "Specialties".

2.4 THERMOMETERS

- A. Pipe line thermometers shall be type as specified in Section 23 0510, Mechanical Basic Materials and Methods "Specialties". Ranges shall be manufacturer's standard closest to the following:
  - 1. Hydronic Heating System: 25 degrees to 300 degrees F.
- B. Pipeline Locations:
  - 1. Supply and Return lines for each water heater hydronic system.

2.5 PRESSURE GAUGES

- A. Gauges shall be type specified in Section 23 05 10 Mechanical Basic Materials and Methods "Specialties".
- B. Provide gauge piping from pump suction and discharge flange to common pressure gauge for each boiler pump and primary pumps. Pressure taps shall be provided for pressure readings at pump suction and pump discharge. Pressure piping shall be 1/4" copper with compression fittings. Provide ball valves at each pressure tap line.

2.6 HYDRONIC SPECIALTIES

- A. Provide hydronic heating specialties for installation in piping system as noted on the Drawings and/or specified herein.
  - 1. Expansion Tanks: Size as noted on the drawings, fabricated steel shell, provide ASME rated and labeled per Section VII, Div. 1 for 125 psig, replaceable bladder for systems specified.
  - 2. Air Separators: size as specified on the drawings.
  - 3. Air vents for terminal units shall be manual vent coin operated vents.
  - 4. Multi-Purpose Valves: Provide Multipurpose, balancing, shut-off check valve assembly for each base mounted pump, valve assembly shall be of the same manufacturer as the pump, cast iron body bronze trim, brass gauge and temperature ports.

5. Hydronic specialties specified above as manufactured by Bell & Gossett, Wilo, Armstrong or Taco are acceptable for this project.
6. Use the same manufacturer for specialties through this project.
7. Provide Glycol Injection Pump, tank and controls as specified on drawings. The glycol system shall be flushed and filled with 50% concentration of propylene glycol with inhibitors.

2.7 GLYCOL

- A. Provide non-toxic propylene glycol-based antifreeze shall be supplied by Noble Company to protect the entire heating system from freeze damage.
- B. NOBURST Hydronic Antifreeze System shall be manufactured by Noble Company.
- C. Installers shall be experienced in (boiler/heating/cooling) system installation/servicing and knowledgeable of Noble Company's antifreeze products and installation procedures.
- D. Provide NOBURST System Pre-Cleaner in the amount of one (1) pint per fifty (50) gallons
- E. Antifreeze fluid in the amount of (50% of system capacity) NOBURST -100, AL, HD or Super NOBURST)
- F. Hydronic Antifreeze as provided by Noble Company.
- G. NOBURST test instruments and record tag shall be as provided by Noble Company.
- H. Material Minimum Performance Criteria, Meets ASTM D1384 Acceptable Maximum for Antifreeze.
- I. The installed antifreeze solution shall provide burst protection to (-60 deg. F), allow fluid flow of (10 deg. F), and contain adequate corrosion inhibitors.
- J. Verify that the boiler and piping system is air tight and in good operating condition.
- K. Boiler cleaning method shall be as recommended in Noble Company's NOBURST Installation Instructions. System shall be cleaned, drained and flushed before antifreeze installation.
- L. NOBURST antifreeze and distilled or deionized water shall be introduced into the boiler and piping system employing recommendations in Noble Company's NOBURST Installation Instructions and standard trade practices to avoid contamination and spills. Air and gasses shall be removed from system when full.
- M. Field quality control, Final installed antifreeze concentration and inhibitor shall be verified using the test instruments recommended in Noble
- N. Company's Installation Instructions. Boiler solution sample shall be obtained after system has circulated for not less than 24 hours.
- O. Test shall be conducted in accordance with Noble Company instructions. Propylene glycol concentration shall be (40%). The solution pH shall be a minimum of 8.0 and a maximum of 12.0 with NOBURST.
- P. Volumes, methods, quantities, and test results shall be recorded on the NOBURST record tag. The tag shall be attached to boiler or pipes.

- Q. Fill entire hydronic system with 40% with propylene glycol.

2.8 CIRCULATING PUMPS

A. In-line Centrifugal Pumps:

1. Circulating pumps for hot water heating systems shall be Grundfos or equal, style pumps as scheduled on the drawings. The pump internals shall be capable of being serviced without disturbing piping connections. Centrifugal pumps shall be fitted with a mechanical seal. The impellers shall be of the enclosed type, hydraulically and dynamically balanced and keyed to the shaft and secured by a suitable locking cap-screw. The motors shall meet NEMA specifications and be up to standards required for industrial use.
2. Each pump shall have capacities as scheduled on the Drawings. Motors shall be 1750 or 3300 rpm, voltage and phase as scheduled. Shop drawings shall include pump impeller diameter, system curve, and pump operating curves for single pump operation.
3. Pump motors shall be selected to be non-overloading over the entire range of the pump curve.
4. Pumps shall be selected near their point of peak efficiency allowing for operation 25 percent beyond the indicated capacity. The impeller diameter shall be selected such that the design capacity does not exceed 90 percent of the capacity obtainable with the maximum impeller at the design speed of that model.
5. Pumps shall be suitable for 200 degrees F. water, with flanged connections. Flanges shall be drilled and tapped for test gauges. Casing and seals shall be designed for not less than 150 psig working pressure.
6. Centrifugal pump motors shall be continuous duty drip-proof construction with grease lubricated ball bearings.
7. Before starting the pump, this Contractor shall furnish the Architect/ Engineer with certified readings of pump head, GPM, motor amperes and volts under full load conditions.
8. In-line circulator pumps shall be flanged wet rotor or centrifugal circulators as specified.
9. Provide ECM type where specified equal to Grundfos or Wilo Stratus, flanged wet rotor circulator with EC motor and automatic capacity adjustment, these pumps shall be furnished with on-board control electronics for variable speed pumping. The specified variable speed pumps shall include remote communication modules to allow communication over the internet or other transparent communication suitable for integration with the DDC control system. Control modules shall be provided for lead lag pump installations where dual pump lead/lag pumps are specified to allow for automatic lead lag and alternation control of these pumps.

2.9 ELECTRIC DUCT COILS

- A. Provide open coil electric duct heaters of the size, capacity and performance shown on the job schedule. All duct heaters shall be tested and certified to UL STD 1996 UL File number E245517. Heating elements shall be open coil type, 80% nickel 20% chromium, type A resistance wire.
- B. Coils shall be supported by steatite ceramic bushings securely fastened to the element support brackets. The duct heater frame, control enclosure and element support brackets shall be of 20 gauge (minimum) galvanized steel. The controls enclosure shall be NEMA-1 construction with standard door interlocking disconnect switch. The electric heater frame shall have flanged or slip-in duct connection. All heaters shall be furnished with a disc type, primary automatic reset thermal cut-off. A secondary manual reset thermal cut-off will also be provided.



- C. All heaters will have an integral air flow switch or a fan interlock relay. The electric supply wiring shall have insulation rating of 221°F (105°C). Terminal blocks and ground lugs will be furnished on all heaters for field wiring. A line voltage to 24 volt, class II transformer shall be provided and mounted inside the control enclosure. All heaters shall have a disconnecting magnetic contactor(s) with a 24-volt holding coil as standard.
- D. Provide SCR control with discharge air sensor to modulate electric heating coil to maintain discharge air temperature.

## 2.1 ELECTRIC WALL HEATERS

- A. Contractor shall supply and install heavy duty wall mounted forced air electric heaters of the wattage, voltage and phase as indicated on the plans. The heater shall so be designed to provide an even distribution of heated air to the space to be heated by drawing return air in the peripheral area of the heater across and through the element which shall then be discharged from the heater by means of an electric motor and fan.
- B. Heaters shall be recessed type to extend no more than 1/2" from the finished wall
- C. Louvers shall be welded at every intersection to three evenly spaced 1/16" diameter vertical members and completely framed in a heavy gauge natural anodized aluminum extrusion. Front assembly shall be attached to the chassis by hidden tamper-resistant (Allen-head) machine screws. All other parts shall be 16 ga. steel zinc coated, both sides finished in a high gloss bronze colored baked enamel.
- D. Motor shall be a permanently lubricated unit bearing, totally enclosed shaded pole type with impedance protection. Motors shall operate at no more than 1400 RPM and shall be same voltage as the heater. A protective shield shall surround the motor to separate return air from heated air.
- E. Element assemblies shall consist of two or three corrosion resistant steel sheathed type elements mechanically bonded to common corrosion resistant steel fins. Each sheathed element shall consist of helically coiled nickel chromium alloy resistant wire completely embedded in and surrounded by magnesium oxide, enclosed and wedged into corrosion resistant steel sheaths. Elements shall have 2" cold conductor pins extending into the sheath and shall have a density of no more than 60 watts per inch.
- F. Heaters shall be equipped with a "zero voltage reset" thermal overload which disconnects elements and motor in the event normal operating temperatures are exceeded. For safety, if opened due to abnormal temperature, thermal overload shall remain open until manually reset by turning heater off for five minutes. Automatic reset thermal overloads which allow the element to continue to cycle under abnormal conditions will not be accepted.
- G. Heaters shall be Underwriters' Laboratories listed. Heaters shall conform to Underwriter's Laboratories, Inc. standard 2021, and shall not be required to have any "CAUTION" marking on the front of the heater. Heaters not conforming to these paragraphs will not be acceptable.
- H. Heaters shall be operated from wall-mounted, low voltage 24 VAC thermostats and shall be provided with control relays to allow heaters to operate from field controller.
- I. Heater shall be equipped with a Class 2 control transformer, sealed rating of 20 VA, to supply control circuits of 24 volts.

- J. Heaters shall be equipped with built-in circuit breakers in order to allow the heaters to be supplied from feeder taps. A separate switch providing a positive off for control circuits shall be included where required. Circuit breakers and control switches shall be arranged so that all line side conductors will be separately enclosed when heater front is removed for servicing so that no current carrying parts are accessible without the use of additional tools..

## 2.2 ELECTRIC BASEBOARD RADIATION

- A. Furnish and install where indicated on plans, electric baseboard heaters, suitable for continuous operation as manufactured by Berko, A Marley Engineered Products Brand, Bennettsville, SC.
- B. Heaters shall be cULus listed.
- C. The heaters shall be fabricated of minimum .024 inch steel with minimum .035 inch steel control boxes. Junction box enclosure to have provisions for incoming and outgoing cable with cable clamp for restraining without additional hardware. Ground wire pigtail provided in each junction box for grounding.
- D. The front cover shall be fabricated of minimum 0.26 inch pre-painted steel.
- E. The heating element wire shall consist of 80% nickel, 20% chromium, and shall be encased in steel sheath to assure long and trouble free life. Aluminum fins shall be so designed as to block sheath radiation to front and back of heater body and pressure bonded to the steel sheath.
- F. Heaters shall be designed to permit use of supply conductors with 60°C insulation.
- G. Provide low voltage relay with transformer to allow heater to be controlled by 24VAC thermostat.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Examine areas and conditions under which hydronic piping, equipment and systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner.

### 3.2 INSTALLATION OF HYDRONIC PIPING

- A. Install hydronic piping in accordance with Section 23 05 10, Mechanical Basic Materials and Methods Section.
- B. Install piping with 1/8" per foot upward slope in direction of flow. Install air vent at all high points in piping.
- C. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- D. Install supports and anchors in accordance with Section 23 05 10, Mechanical Basic Materials and Methods Section.

- E. Sectional Valves: Install on each branch, close to main, where branch serves hydronic terminals or equipment connections, and elsewhere as indicated.
- F. Shutoff Valves: Install on inlet and outlet of each mechanical equipment item, and each hydronic terminal, and elsewhere as indicated to isolate all radiation and equipment for maintenance and repair.
- G. Drain Valves: Install on each mechanical equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system and elsewhere indicated or required to completely drain hydronic piping system.
- H. Equipment Connections: Connect hydronic piping system to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated. Install shutoff valve and union on supply and return, drain valve on drain connection. Where indicated, install automatic temperature control valve with unions and gate valves.
- I. Piping Tests: Test hydronic piping in accordance with testing requirements of Section 230510, Mechanical Basic Materials and Methods Section.
- J. Cleaning, Flushing and Inspecting: Clean, flush and inspect hydronic piping systems in accordance with General Requirements of Section 23 05 10, Mechanical Basic Materials and Methods Section.

### 3.3 VALVES

- A. Valves shall be full size of piping in which they are installed and shall not be reduced to pump, coil, or temperature control valve size unless specifically noted on drawings.

### 3.4 EQUIPMENT

- A. All items of equipment shall be carefully installed where indicated on the drawings so as to present a neat finished appearance. Any item which does not, in the opinion of the Architect/Engineer, conform to the above will be removed, replaced, and refitted at no expense to the Owner.

### 3.5 INSTALLATION OF PUMPS

- A. Install pumps where indicated, in accordance with manufacturer's published installation instructions, complying with recognized industry practices to ensure that pumps comply with requirements and serve intended purposes.
- B. Provide access space around pumps for service, maintenance and removal indicated, but in no case less than that recommended by manufacturer.
- C. In-line pumps in general shall be supported from piping system. Install each pump with isolating valve unions or flanges in piping connection to permit removal.
- D. Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable.

- E. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
- F. Refer to Section 23 05 10, Mechanical Basic Materials and Methods Section for testing, adjusting and balancing of pumps and piping systems.

### 3.6 INSTALLATION OF HYDRONIC SPECIALTIES

- A. General: Examine areas and conditions under which hydronic specialties are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
- B. Balance Valves: Install balance valve on each hydronic zone circuit, or discharge of each hydronic pump, and elsewhere as indicated. After hydronic system balancing has been completed, lock each balance cock in the final balanced position.
- C. Manual Vent Valves: Install manual vent valves on each hydronic terminal at highest point.
- D. Air Vent Valves: Install manual vent valves at top of each hydronic riser at highest point and elsewhere as indicated. Install ball valve between riser and air vent.

### 3.7 ELECTRICAL WIRING

- A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electric Installer.
- B. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 Section. Do not proceed with equipment start-up until wiring installation is acceptable to Equipment Installer.

### 3.8 ADJUSTING AND CLEANING

- A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.
- B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- C. Test and balance Hydronic System, equipment, controls and accessories in accordance with Section 23 05 10, Mechanical Basic Materials and Methods Section.

**END OF SECTION 23 21 13**

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## SECTION 23 31 13 – AIR DISTRIBUTION SYSTEMS AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 GENERAL REQUIREMENTS

##### A. Related Work Specified Elsewhere:

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Mechanical Work passing through membrane roof is specified in Division 7.
5. Finish Painting is specified in Division 9.
6. Plumbing Work is specified in Division 22.
7. Electrical Work is specified in Division 26.

##### B. Related Documents:

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of Section 23 05 00 govern the work specified in this Section, where applicable.

#### 1.2 DESCRIPTION OF WORK

##### A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Dryer vent ducting and intake ducts and wall caps.
2. New air distribution system including dampers, intakes and accessories.
3. Testing and balancing of new fan coil unit air systems and heat recovery unit air systems.
4. Fire Dampers
5. Combination Fire/Smoke Dampers
6. Kitchen exhaust hood and exhaust ductwork.

#### 1.3 CODES AND STANDARDS

##### A. Air distribution systems and equipment shall comply with the following as applicable:

1. Electrical: Provide electric motors and products which have been listed and labeled by Underwriter's Laboratories and comply with NEMA Standards.
2. Comply with National Electrical Code (NFPA No. 70) as applicable to installation of fan motors and associated electric wiring and equipment.

##### B. Fans

1. Comply with Air Movement and Control Association Standards pertaining to testing, performance and sound ratings of fans.
2. Comply with SMACNA's duct construction standards.
3. Provide fans whose performance, under specified conditions, is certified by manufacturer.

C. Sheet Metal Ducting

1. Comply with SMACNA recommendations for fabrication, construction and details and installation procedures, except as otherwise indicated in these specifications.
2. Comply with ASHRAE recommendations, except as otherwise indicated in these specifications.

D. Dampers

1. Comply with AMCA Standard 500-75, "Test Methods for Dampers and Shutters", as applicable testing performance.
2. Comply with National Electrical Code (NFPA 70), as applicable to electrically operated dampers.
3. Except where more stringent leakage limitation is indicated, provide dampers with leakage limited to 10 CFM per sq. ft., at 4" W.G. static pressure.
4. Comply with SMACNA duct construction standards as applicable and damper installation requirements of N.F.P.A.

1.4 SUBMITTALS

- A. Submit complete manufacturer's data and shop drawings on Air Distribution Systems and Equipment in accordance with requirements of Section 15010, include the following:
  1. Duct construction methods and materials
  2. Diffusers, registers, grilles and louvers
  3. Dryer vent and intake ductwork including wall caps
  4. Exhaust Fans
  5. Control dampers and actuators
  6. Fire Dampers
  7. Combination Fire/Smoke Dampers
  8. Kitchen exhaust hood and exhaust ductwork.
- B. Product Data: Submit manufacturer's technical data for all equipment, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished and installation instructions.
- C. Shop Drawings: Submit assembly-type shop drawings showing equipment dimensions, construction details, methods of assembly of components and field connection details.
- D. Submit manufacturer's electrical requirements for power supply wiring to power equipment. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- E. Submit maintenance data and parts list for each piece or type of equipment, accessory and control. Include this data and product data in maintenance manual; in accordance with requirements of Section 23 05 10.

PART 2 - PRODUCTS

2.1 COMBINATION FIRE SMOKE DAMPERS

- A. Dampers shall be Greenheck or approved equal, combination fire smoke dampers.
- B. Dampers shall comply with the following:
  - 1. AMCA 500-D – Laboratory Methods for Testing Dampers for Ratings.
  - 2. AMCA 511 – Certified Ratings Program for Air Control Devices.
  - 3. CSFM – California State Fire Marshall Listing for Fire Damper and Smoke Damper (leakage).
  - 4. New York City MEA – New York City, Department of Buildings, Material and Equipment Acceptance Division.
  - 5. IBC – International Building Code
  - 6. NFPA 80 – Fire Doors & Other Opening Protectives
  - 7. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.
  - 8. NFPA 92 – Standard for Smoke Control Systems
  - 9. NFPA 101 – Life Safety Code.
  - 10. NFPA 105 – Standard for the Installation of Smoke Door Assemblies
  - 11. UL 555 (Seventh Edition) – Standard for Safety: Fire Dampers
  - 12. UL 555S (Fifth Edition) – Standard for Safety: Smoke Dampers
  - 13. FM Approval
- C. Dampers shall have a minimum 1 ½ hour rating.
- D. Each combination fire-smoke damper shall be equipped with a factory installed heat responsive device rated to close the damper when the temperature at the damper reaches 165 deg. F. Dampers shall have a UL555S leakage rating of Leakage Class I, (8 cfm/ft<sup>2</sup> (0.04 m<sup>3</sup>/ s/m<sup>2</sup>) at 4 in.wg. (1.0 kPa). Dampers shall have a UL 555S differential pressure rating of 4 in. wg. Dampers shall have a UL 555S velocity rating of 2000 fpm.
- E. The Damper Manufacturer's submittal data shall certify that all pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3, and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal.
- F. AMCA certified pressure drop for a 24 in. wide x 24 in. high damper shall not exceed 0.09 in. wg when subjected to an airflow velocity of 1500 fpm according to AMCA Test Figure 5.3. (FSD-200 series)
- G. The Damper Manufacturer's submittal data shall certify that all pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3, and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal.
- H. AMCA certified pressure drop for a 24 in. wide x 24 in. high damper shall not exceed 0.06 in. wg when subjected to an airflow velocity of 1500 fpm according to AMCA Test Figure 5.3. (FSD-300 series)
- I. The Damper Manufacturer's submittal data shall certify that all pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3, and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal.



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- J. AMCA certified pressure drop for a 24 in. wide x 24 in. high damper shall not exceed 0.09 in. wg when subjected to an airflow velocity of 1500 fpm according to AMCA Test Figure 5.3. (FSD-200 series)
- K. The Damper Manufacturer's submittal data shall certify that all pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3, and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal.
- L. AMCA certified pressure drop for a 24 in. wide x 24 in. high damper shall not exceed 0.06 in. wg when subjected to an airflow velocity of 1500 fpm according to AMCA Test Figure 5.3. (FSD-300 series)
- M. The Damper Manufacturer's submittal data shall certify that all pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3, and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal.
- N. AMCA certified pressure drop for a 24 in. wide x 24 in. high damper shall not exceed 0.09 in. wg when subjected to an airflow velocity of 1500 fpm according to AMCA Test Figure 5.3. (FSD-200 series)
- O. The Damper Manufacturer's submittal data shall certify that all pressure drop data is licensed in accordance with the AMCA Certified Ratings Program for Test Figures 5.2, 5.3, and 5.5. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal.
- P. AMCA certified pressure drop for a 24 in. wide x 24 in. high damper shall not exceed 0.06 in. wg when subjected to an airflow velocity of 1500 fpm according to AMCA Test Figure 5.3. (FSD-300 series)
- Q. Blade Edge: Blade seals shall be extruded silicone rubber mechanically secured to the appropriate blade edges.
- R. Jamb: Flexible stainless steel compression type.
- S. Blade linkages shall be non-adjustable and concealed within the jamb of the damper.
- T. Axles: Minimum ½ inch dia. zinc plated steel.
- U. Dampers shall be supplied with RRL.
- V. Axle bearings shall be stainless steel sleeve type rotating in polished extruded holes in the damper frame.
- W. Sleeves: Damper shall be supplied as a single assembly with a factory installed sleeve made of material matching that of the damper.
- X. Finish to be Galvanized steel.
- Y. Electric, 24V AC, 2-position or Electric, 24V DC, 2-position, coordinate with the fire alarm system.
- Z. Provide external mounting location.
- AA. Provide remote test switch.
- BB. Provide factory mounted, No flow smoke detector rated for 0-3000 FPM.

- CC. Install unit in accordance with the listing with retainer angles.
- DD. Provide break away connections.
- EE. Provide duct mounted access doors.

## 2.2 FIRE DAMPERS

- A. Provide where shown or indicated on the drawings fire dampers with a UL Label for not less than 1-1/2 hour fire protection rating in accordance with US-555 continuing inspection service. Blades and frame shall be galvanized steel construction with blades of an interlocking design, having two folded guides which serve as stops. Fusible links shall be equal to Grinnell Figure 1351, 20 pounds, Issue A.
- B. Dampers shall be installed according to latest edition of NFPA-90A, mounted with 1-1/2" x 1-1/2" x 1/8" returning angles on both sides of partition wall or floor and sleeves as per the UL test under which the damper fire rating was obtained. Angles shall completely close the wall opening and provide anchorage to the dampers.
- C. Dampers shall be as manufactured by Ruskin Air Balance, Inc., Phillips, A.F.F. Co., United Sheet Metal, Inc., or other equal as approved by the Architect/Engineer, equal to Ruskin Model IB2. Damper style shall be horizontal or vertical Type A, B, or C as directed by the location and duct shape (rectangular, square, round, or flat oval) in which the dampers are installed. Unless otherwise approved by the Architect/Engineer, no open damper shall decrease the net free area of the duct by more than 15 percent.

## 2.3 VOLUME DAMPERS

- A. Duct system shall have sufficient volume dampers, whether or not shown, to control and adjust the total volume of each system, each zone, in each branch, and at each diffuser or grille. Volume dampers shall be of the butterfly type with 16 gauge galvanized iron blade. All dampers shall be equipped with Duro-Dyne Type UNXLD locking quadrant. Dampers 25" in width and longer shall be provided with damper bearings on each end of shaft. Bearings shall extend through ducts with the one opposite quadrant mounted on a 2" x 3" x 1/8" plate held to duct with sheet metal screws. Maximum width of single blades shall be 14".

## 2.4 WALL LOUVERS

- A. Wall louvers shall comply with National Fire Protection Association Standard No. 90A, as applicable to louver construction. Wall louvers shall be manufactured by Ruskin, Arrow or Carnes.
- B. Provide all wall louvers where indicated. Deliver to the General Contractor to be built-in to construction. Material shall be aluminum channel box frame with extension sill as required, and blades with 1/2" mesh No. 19 gauge galvanized wire bird screen, duct collars and stainless steel screws. Screen shall be pre-coated.
- C. Louvers to be provided with custom baked enamel finish, Architect to provide custom color chip for matching by the manufacturer.

2.5 AIR GRILLES AND REGISTERS AND DIFFUSERS

- A. Grilles and registers shall be Price, Metal Aire, or equal by Carnes, equal to those listed on the drawings. See Drawings for sizes, CFM's, locations, and qualities of various types. In general, all units shall be installed with face bars parallel to floor or nearest wall. All volume control dampers shall be key operated. Finish for all diffusers, grilles, and registers to be factory finished with color selected by the Architect/Engineer.
- B. All grilles, and registers, shall be equal to model numbers as scheduled on Drawings.

2.6 FLEXIBLE CONNECTIONS

- A. Provide in each duct connection to every fan and variable air volume box 30 ounce double neoprene coated woven glass fabric flexible connection not less than 4" long securely held to retaining clamps.

2.7 VIBRATION ISOLATION MOUNTS

- A. Furnish and install vibration isolation bases and supports for all fans and air handling units and their motors, as manufactured by Korfund, Mason Industries, or Vibration Eliminator Co., selected for isolation efficiency of not less than 90 percent equal to the following. In general, the vibration isolation units shall be selected and furnished by the fan equipment manufacturer or supplier, but shall in no case be less than those specified.
- B. Isolation supports for heat recovery units, exhaust fans, fan coil units and air handling units and fans suspended from overhead construction support framing shall be hanger type equal to Mason Type 30N consisting of a rubber element and a spring with a total combine deflection occurring in the spring. Install with rubber element closest to the overhead construction.
- C. Heat recovery units shall be provided with spring isolator hangers or base spring isolators as noted on the drawings.

2.8 DRYER EXHAUST DUCT SYSTEM

- A. Dryer exhaust ductwork shall be NordFab QF piping, 22 gauge stainless steel ductwork and fittings with Quick seal clamps.
- B. Install for the ability to allow the system to be disassembled for cleaning.
- C. Install in compliance with the manufacturer's published instruction.

2.9 ACOUSTIC DUCT LINER

- A. Acoustic duct liner is specified in Section 23 07 19, "Mechanical System Insulation".

2.10 FLEXIBLE AIR DUCT

- A. Flexible air duct shall be Buckley, Thermoflex, Cleveflex, or equal and shall be equal to Buckley low pressure "FARBIFLEX", flexible UL listed duct. No flexible duct permitted in attic.

- B. Flexible duct shall be manufactured from aluminum and formed into a multiple corrugated construction; supply duct shall be encased with 1", 3/4 pound density fiberglass blanket and sheathed with a vinyl vapor barrier. The duct shall have an inside bending radius of not more than 3/4 of its I.D. It must comply with the latest N.F.P.A. Bulletin 90A and be listed as Class 1 air duct, U.L. Standard 181. Duct shall have published pressure ratings of not less than 12" W.G. positive pressure, 12" W.G. negative pressure.
- C. Ducts shall be supported with metal straps maximum 4'-0" O.C. Flex duct shall be securely bolted to diffuser duct branch with metal band clamps. Support all flexible duct runs per SMACNA standards.
- D. Maximum flexible duct runs shall be 6'-0".

2.11 EXHAUST FANS

- A. Furnish and install ceiling exhaust fans as scheduled on the Drawings or approved equal. Units shall include fan housing, blower motor, ceiling register, and duct connection, designed for maximum sound level scheduled. Provide specified weather cap with back draft damper.
- B. Exhaust fan motors shall be ECM variable speed fans as specified, provide local speed control switch to allow for balancing.
- C. Units shall be manufactured by Greenheck, Panasonic or approved equal.
- D. Provide neoprene isolators for threaded rod hangers.
- E. Provide fan mounted speed control switch for balancing.

2.12 DORM KITCHEN EXHAUST HOOD AND CONTROLS

- A. Hood to be Accurex Model XRRS-W-36-T-E-O-E.
- B. Provide in-line fan as scheduled.
- C. Hood shall include factory-installed UL Subject 300A fire suppression system, including fully monitored electronic detection and actuation. No braided cable or fusible links shall be accepted. Fire suppression shall consist of two (2) mounted metal-housed temperature sensors that monitor the cooking surface and upon reaching set-point, send a signal back to the main fire system control board, which activates the tank solenoid valve and expels the wet chemical from a pre-charged tank responsible for suppressing the fire. Tank pressure shall be monitored using tank pressure sensor and a fault must be displayed on the user interface if low pressure is detected. All fire suppression and control components must be easily accessible by dropping the hood into a service position to allow for service without removing the hood. Latches shall be utilized to hold the hood into place for normal operation. No thumb screws or removable hardware are acceptable. Hood system shall include either an electronic off device that shall be field connected back to the hood via factory-provided plug and play cables. Prior to fire suppression release, the shut off device shall be responsible for disabling the range upon detecting a high temperature. Electric disconnect shall include a 4- prong 250VAC 50A power receptacle.
- D. Hood system with option for NFPA 101 compliance, shall include a 500 CFM fan, locked (password protected) appliance disconnect with timed-automatic range deactivation, and manual pull station. User interface shall be provided to control fan, range, and lights and view system statuses, including faults/alarms. User interface shall be full color 4.3" LCD touch screen. No toggle switches or rheostats

shall be acceptable. All factory and configuration settings must be accessed by touchscreen through password-protected entry.

- E. For ADA compliance, the user interface shall be shipped loose to be field mounted on a wall near the hood. User interface shall be provided with factory supplied plug and play cable. The hood system shall be configured as with either a factory-supplied integral fan, factory supplied external fan. Integral fan options include either front recirculating or rear discharge. External fan options shall include either a factory-provided inline fan (with plug and play cable) with a top discharge hood configuration. Top discharge shall direct the air to exit the top of the hood, to discharge through wall to the outside All factory provided fan options shall include energy efficient electrically commutated motors (ECM) standard.
- F. Hood operation shall be as follows:
  - 1. User interface can be utilized to turn on and off fans, lights, and range disconnect.
  - 2. If configured for NFPA 101 life safety code, password entry will be required to engage disconnect. After range is turned on, count down timer will begin, and upon expiring will disengage the range disconnect.
  - 3. Upon reaching specific set-point, exhaust fan will engage automatically if not already turned on and be forced to a speed based on a temperature range.
  - 4. Upon reaching a second higher temperature set-point, the disconnect will be automatically shut off and a warning will appear on the user interface.
  - 5. Upon reaching a preset temperature, the fire system will engage and discharge wet chemical on top of the range. The system can also include the following options:
    - a. Enclosure panels to close-off the space above the hood to the ceiling Finished top, when no overhead cabinets are enclosing the top of the hood
    - b. Wall cap
    - c. Horn strobe, with plug and play cable
    - d. K-class 6 liter wet chemical fire extinguisher
    - e. Manual pull station, with plug and play cable (included automatically with NFPA 101 compliance)
    - f. Dry contacts are provided standard for tie into building alarm systems and supply fan integration.

**2.13 FACULTY RESIDENCE KITCHEN EXHAUST HOOD AND CONTROLS**

- A. Range hood shall be Broan Model BUF4. Unit shall be convertible between ducted using a washable aluminum filter (included) and non-ducted (purchase nonducted filter separately).
- B. Motor to be permanently lubricated. RPM not to exceed 2850. Unit shall have a two-speed fan switch with separate light switch.
- C. Sides shall be mitered and bottom edge hemmed - with no sharp edges. Air delivery shall be no less than 160 CFM and sound levels no greater than 7.5 Sones (6" diameter), 160 CFM at 7.0 Sones. All air and sound ratings shall be certified by HVI. Unit shall be U.L. listed.

PART 3 - EXECUTION

3.1 SHEET METAL WORK

- A. Work shall be erected in a first-class and workmanlike manner, in accordance with the "Low and Medium Velocity Duct Standard", and "HVAC Duct Construction Standards", latest editions, published by the Sheet Metal and Air Conditioning Contractors' National Association, Inc. and as specified within these specifications. Where these specifications exceed these standards, the specifications shall be followed. All ducts, unless otherwise approved, shall be true to the dimensions indicated on the plans and shall be straight and smooth on the inside, with neatly finished joints.
- B. The ducts shall be securely anchored to the building construction in an approved manner, and shall be so installed as to be completely free from vibration under all conditions of operation. The Contractor shall furnish and erect all necessary supports and cross-framing required for ducts and equipment.
- C. All slip joints shall be made in direction of air flow. Branches to and from the main trunk shall be made at an angle approved by the Architect/Engineer, but shall in no case exceed 45 degrees to the line of air flow.
- D. All notches for connecting sections of duct and all grooving seam notches shall not be cut any deeper than necessary to insure tight corner. Any notched corners not meeting with the approval of the Architect/Engineer shall be removed and reinstalled or sealed with solder, subject to the approval of the Architect/Engineer.
- E. Where galvanized sheet metal ducts connect to bronze or copper louvers or other apparatus of dissimilar materials, the connections shall be fitted with neoprene gaskets.
- F. Elbows, where space permits, shall be fabricated with inside radius no less than the dimension of the duct in the plane of the elbow. Turning vanes shall be used where short radius or square elbows are used. Vanes in square elbows shall be spaced on 3" radius on the diagonal for ducts up to 24" wide, 6" radius for ducts 25" to 36" wide, and 7" radius for ducts 37" to 48" wide. All vanes in galvanized ducts shall be as specified and must be rigid so as not to rattle or vibrate in the air stream.
- G. This Contractor shall be responsible for the coordination of the sheet metal installation with the work of all other trades. Work shall be so installed that headroom is maximum possible and coordination with other trades in accomplishing this is mandatory.

3.2 HANGERS AND SUPPORTS

- A. Support drops from overhead main at top and bottom of drop and ends of horizontal runs and elsewhere as required with split clamps and protecting saddles anchored to building steel or wall to prevent sway.
- B. Duct Support: Galvanized steel angles securely fastened to duct and suspended from building structural framing.
- C. Equipment Supports: All equipment shall be firmly supported on, or suspended from, the building structure. Steel angles, fasteners, rods, and vibration eliminator units required to support the equipment without undue transmission of vibration through the building shall be furnished and installed by this Contractor.

3.3 CLEANING OUT THE AIR SYSTEM

- A. No fans shall be run for temporary heating, ventilating, testing, or otherwise. If systems are not properly closed-off during construction the engineer may require the systems to be professional cleaned and tested.
- B. Upon completion of construction and before testing, the interior of all air handling units and plenums shall be vacuum cleaned to remove all construction dirt, dust, etc. before the units are turned on.

3.4 HVAC SYSTEM ADJUSTMENT

- A. The final adjustments and balancing of the air systems and the temperature control system shall be performed by an independent certified Balancing Contractor under the supervision of the Architect/Engineer. All labor and instruments necessary to complete this work shall be provided by the Balancing Contractor. The temperature control manufacturer shall provide labor and technical assistance as required by the Balancing Contractor.
- B. Prior to this final adjusting and balancing, this Contractor shall have thoroughly checked and tested all parts of the system for complete and proper piping connections, proper electrical connections, proper lubrication of all parts and equipment, proper direction of rotating for equipment, control all piping, and otherwise see that all systems are mechanically and electrically complete.
- C. Immediately following the completion of the adjusting and balancing of the systems, final readings shall be taken and recorded of all electrical loads for motors and heating equipment. After all data is recorded, a final functional test of all systems will be performed to verify their operation and demonstrate to the Owner the performance and operating procedures for the systems.
- D. Functional Checking of the Systems
  - 1. Verify that exhaust fans and heat recovery units properly sequence.
  - 2. If a problem exists after all previous steps have been properly executed and everything seems to agree with the design specifications, notify the Architect/Engineer.
- E. Defective Work: If inspection or tests indicate defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests repeated. Repairs to piping shall be made with new materials. No caulking of screwed joints or holes will be acceptable.

END OF SECTION 23 31 13

**SECTION 23 72 00 - HEAT RECOVERY UNITS**

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Related Work Specified Elsewhere:

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Mechanical Work passing through roof is specified in Division 7. Provide roof flashing boots for all mechanical roof penetrations for installation by the roofer.
5. Finish Painting is specified in Division 9.
6. Plumbing Work is specified in Division 22.
7. Electrical Work is specified in Division 26.

B. Related Documents:

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of Section 23 05 00 govern the work specified in this Section, where applicable.

1.2 DESCRIPTION OF WORK

A. This section includes indoor heat recovery units, these units will be furnished and installed by the Contractor. Provide all labor and materials to provide a complete and operating system.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data for each unit indicated, including the following:
  - a. Certified fan performance curves with system operating conditions indicated.
  - b. Certified fan sound power ratings.
  - c. Certified coil performance ratings with system operating conditions indicated.
  - d. Motor ratings and electrical characteristics plus motor and fan accessories.
  - e. Materials gages and finishes.
  - f. Filter with performance characteristics.
  - g. Dampers, including housings, linkages, and operators.
2. Shop drawings from manufacturer detailing dimensions, required clearances, components, and location and size of each field connection.



3. Coordination drawings for heat recovery unit in accordance with Section 23 0510 "Mechanical Basic Materials and Methods."
4. Wiring diagrams detailing wiring for power and controls and differentiating between manufacturer-installed wiring and field- installed wiring.
5. Product certificates signed by manufacturers of heat recovery unit certifying that their products comply with specified requirements.
6. Field quality control test reports specified in Part 3 of this Section.
7. Maintenance data for unit for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23 Section "Mechanical Basic Mechanical Requirements."

#### 1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Heat recovery unit and components shall be designed, fabricated, and installed in compliance with NFPA Standard 90A "Standard for the Installation of Air Conditioning and Ventilating Systems."

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Lift and support units with the manufacturer's designated lifting or supporting points.
- B. Disassemble and reassemble unit as required for movement into the final location following manufacturer's written instructions.
- C. Deliver heat recovery unit as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

#### 1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of support curbs and openings with existing structural truss systems and concrete work.
- B. Coordinate the size and location of structural steel support members.

#### 1.7 EXTRA MATERIALS

- A. Furnish one additional complete set of filters for heat recovery unit.
- B. Obtain written receipt from Owner.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following the basis of design is RENEW-AIRE. Contractor shall submit complete coordination plans if alternate manufacturer is used.

1. Life Breath
2. Xetex, Inc.
3. Heatex, Inc.
4. DesChamps, Inc.

**2.2 PACKAGED HEAT RECOVERY UNIT GENERAL REQUIREMENTS**

A. Product Specification: Energy Recovery Ventilator (ERV) shall be a packaged unit as manufactured by RENEW-AIRE and shall transfer both heat and humidity using static plate core technology.

B. Quality Assurance

1. The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacture's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI Certified will not be accepted.
2. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
3. Unit shall be Listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers.
4. The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.

C. Energy Transfer

1. The ERV shall be capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.

D. Passive Frost Control

1. The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

E. Continuous Ventilation

1. Unit shall have the capacity to operate continuously without the need for bypass, recirculation, pre-heaters or defrost cycles under normal operating conditions.

F. Positive Airstream Separation

1. Water vapor transfer shall be through molecular transport by hydroscopic resin and shall not

be accomplished by “porous plate” mechanisms. Exhaust and fresh airstreams shall travel at all times in separate passages, and airstreams shall not mix.

**G. Laminar Flow**

1. Airflow through the ERV core shall be laminar over the products entire operating airflow range, avoiding deposition of particulates on the interior of the energy exchange plate material.

**H. Construction**

1. The energy recovery component shall be of fixed-plate cross-flow construction, with no moving parts.
2. No condensate drain pans or drains shall be allowed and unit shall be capable of operating in both winter and summer conditions without generating condensate.
3. The unit case shall be constructed of G90 galvanized, 20-gauge steel, with lapped corners and zinc plated screw fasteners.
4. Access doors shall provide easy access to blowers, ERV cores, and filters. Doors shall have an airtight compression seal using closed cell foam gaskets. Pressure taps, with captive plugs, shall be provided allowing cross-core pressure measurement allowing for accurate airflow measurement.
5. Case walls and doors shall be double walled insulated with 1 inch, 4 pound density, high-density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with minimum R-value of 4.3 (hr·ft<sup>2</sup>·°F/BTU).
6. The ERV cores shall be protected by a MERV 13 rated, 2” nominal, pleated, disposable filter in both airstreams.
7. Unit shall have single-point power connection and a single-point 24 VAC contactor control connection.
8. Blower motors shall be Premium Efficiency, EISA compliant for energy efficiency. The blower motors shall be ECM and be shall be supplied with factory installed separate speed controls both the supply and exhaust fans. Provide a 24 VAC control transformer with control terminals for each control point. Provide unit with a factory disconnect with single point power supply.
9. Blowers shall be quiet running, forward curve type direct drive.
10. Blowers shall be installed on factory spring mounted isolators.
11. The unit electrical box shall include a factory installed, non-fused disconnect switch and a 24 VAC, Class II transformer/relay package.

**I. Options**

1. Provide unit and duct connection orientation per project schedule.
2. Provide double wall construction with 24-gauge galvanized steel liner.
3. Provide motor horsepower as specified in project schedule.
4. Provide factory installed disconnect fuses.
5. Provide factory installed filter monitors for each airstream.
6. Provide MERV-13 filters for final installation after construction phase.
7. Provide factory installed variable speed switch for each fan, mount speed switch in factory control panel.
8. Provide factory installed isolation dampers for both air streams. The insulated dampers shall be of a low leakage design and shall not restrict the airstream, reducing airflow, in any way. The dampers shall be opened with a motor actuator powered by the standard unit

transformer package and have a spring return for low off- position power consumption.

2.3 CONTROL SEQUENCES AND COORDINATION OF CONTROLS

- A. Refer to Automatic Temperature Controls for sequence of control for Heat Recovery Unit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, roof openings and roof curb placement, and other conditions affecting performance of recovery unit.

- B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install recovery unit level and plumb, in accordance with manufacturer's written instructions.

- B. Arrange installation of unit to provide access space around unit for service and maintenance.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties.

- B. Duct installations and connections are specified in other Division 23 sections. Make final duct connections with flexible connections.

C. Electrical Connections: The following requirements apply:

1. Electrical power wiring is specified in Division 26.
2. Temperature control wiring and interlock wiring is specified "Automatic Temperature Controls".
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Inspection: Arrange and pay for a factory- authorized service representative to perform the following:

1. Inspect the field assembly of components and installation of heat recovery unit including piping, ductwork, and electrical connections.
2. Prepare a written report on findings and recommended corrective actions.

- B. Manufacturer's representative shall supervise the start-up of heat recovery unit.

### 3.5 ADJUSTING, CLEANING, AND PROTECTING

A. The Unit and system shall not be started or operated until construction has stopped to prevent construction debris from entering the unit and air system.

- B. Adjust damper linkages for proper damper operation.

C. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face.

### 3.6 COMMISSIONING

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping, blocking, and bracing.
2. Verify unit is secure on mountings and supporting devices and those connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Install clean filters.
7. Disable automatic temperature control operators.

B. Starting procedures for heat recovery unit:

1. Energize motors, verify proper operation of motor, drive system, and fan wheel. Adjust fan to required speed.
2. Measure and record motor electrical values for voltage and amperage.

C. Shut unit down and reconnect automatic temperature control operators.

D. Refer to "Mechanical Basic Materials and Methods" for procedures for testing, adjusting, and balancing.

### 3.7 DEMONSTRATION

A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 and "Basic Materials and Methods".

- B. Schedule training with at least 7 days' advance notice.

### 3.8 HEAT RECOVERY UNIT INSTALLATION

#### A. Unit Location

1. Locate and orient unit to provide the shortest and most straight duct connections. Provide service clearances as indicated on the plans. Locate units distant from sound critical occupancies.
2. Provide a structurally suitable support for the base of any wall mounted or hung units.

#### B. Vibration Isolation

1. For suspended units provide rubber or spring type isolators appropriately sized for corner weights of the specific unit.
2. Provide flexible duct connections at unit duct flanges.

#### C. Duct Design

1. All ductwork shall be designed, constructed, supported and sealed in accordance with SMACNA HVAC Duct Construction Standards and pressure classifications.
2. At a minimum all duct runs to the outdoors shall be thermally insulated at levels appropriate to the local climate. A continuous vapor barrier shall also be provided on warm surface of the insulation.

#### D. Test and Balancing

1. Test and Balancing may not begin until 100% of the installation is complete and fully functional.
2. Follow National Comfort Institute (NCI) air test and balance procedures specific to Heat Recovery Ventilator Balancing Procedure including standard reports to the owner's representative.

END OF SECTION 23 72 00

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## SECTION 23 81 23 - VRF SYSTEMS

### PART 1 - GENERAL

#### 1.1 GENERAL PROVISIONS

##### A. Related Work Specified Elsewhere:

1. Refer to all Sections of DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.
2. Excavation and Backfill are specified in Division 31.
3. Concrete Work is specified in Division 3.
4. Flashing of Mechanical Work passing through membrane roof is specified in Division 7.
5. Finish Painting is specified in Division 9.
6. HVAC Work is specified in Division 23.
7. Sprinkler Work is specified in Division 21.
8. Electrical Work is specified in Division 26.

##### B. Related Documents:

1. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.
2. The requirements of this Section govern the work specified in all other sections of Division 23, as applicable.

#### 1.2 SYSTEM DESCRIPTION

- A. The variable capacity, low ambient heat pump system shall be equal to a Daikin Variable Refrigerant Flow, split system heat pump system.
- B. The system shall consist of outdoor unit, multiple indoor units. The sum of connected capacity of all indoor air handlers shall range from 50% to 130% of outdoor rated capacity.
- C. Systems shall be manufactured by Mitsubishi or approved equal by Daikin.

#### 1.3 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 proposed ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the DOE alternative test procedure, which is based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standards 340/360, 1230 and ISO Standard 13256-1.
- E. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.



1.4 DELIVERY, STORAGE AND HANDLING

- A. Units shall be stored and handled according to the manufacturer's recommendation.

1.5 WARRANTY

- A. The units shall be covered by the manufacturer's limited warranty for a period of one (1) year from date of installation.
- B. In addition the compressor shall have a manufacturer's limited warranty for a period of seven (7) years 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 Engineer.
- D. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.
- E. The system shall be installed by a contractor with extensive install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

**PART 2 - PRODUCTS**

2.1 OUTDOOR UNITS

- A. General: Each outdoor unit shall be specifically used with the specified system components. The outdoor units 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, wired and run tested at the factory.
  - 1. Outdoor unit shall have a sound rating no higher than 60 dB(A) individually or 65 dB(A) twinned. Units shall have a sound rating no higher than 50 dB(A) individually or 55 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. Outdoor unit shall be able to connect to up to 50 indoor units.
  - 3. Both refrigerant lines from the outdoor unit to indoor units shall be insulated.
  - 4. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
  - 5. The outdoor unit shall have a high pressure safety switch, over-current protection and DC bus protection.
  - 6. The outdoor unit shall have the ability to operate with a maximum height difference of 164 feet and have a total refrigerant tubing length of 3280 feet. The greatest length is not to exceed 541 feet between the outdoor unit and the indoor units without the need for line size changes or traps.
  - 7. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
- B. Unit Cabinet:

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished. Unit's cabinets shall be able to withstand 960 hours per ASTM B117 criteria for seacoast protected models.
- C. Fan:
1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan.
  2. The fan motor shall have inherent protection, have permanently lubricated bearings, and be completely variable speed. 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.
  3. The fan motor shall be mounted for quiet operation.
  4. The fan 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 coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
  2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
  3. The coil shall be protected with an integral metal guard.
  4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
  5. 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 18%-4% of rated capacity, depending upon unit size
  4. The compressor shall be equipped with an internal thermal overload.
  5. The compressor shall be mounted to avoid the transmission of vibration.
- G. Electrical:
1. The outdoor unit electrical power shall be 208/230 volts, 3-phase, and 60 hertz.
  2. The unit shall be capable of satisfactory operation within voltage limitations of 187-228 volts. The outdoor unit shall be controlled by integral microprocessors.
  3. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, non-polar twisted pair shielded cable to provide total integration of the system.

2.2 INDOOR WALL MOUNTED UNITS

- A. General: The units shall be a wall-mounted indoor unit section and shall have a modulating linear expansion device and a flat front. The indoor units 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.
- B. 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.
- C. 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.
- D. Filter:
1. Return air shall be filtered by means of an easily removable, 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. Both refrigerant lines to the indoor units shall be insulated.
- F. Electrical:
1. The unit electrical power shall be 208/230 volts, 1-phase, and 60 hertz.
  2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts.
- G. Controls:
1. This unit shall use controls provided with a factory wall mounted controller
  2. The unit shall be able to control external backup heat.
  3. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8 degree F dead band from set point.

**2.3 INDOOR CEILING RECESSED CASSETTE UNITS**

- A. General: Units shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor units 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 units shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor units and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- B. Unit Cabinet:
1. The cabinet shall be space-saving ceiling-recessed cassette.
  2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
  3. Branch ducting shall be allowed from cabinet.
  4. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
  5. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space
- 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 five (5) speed settings, Low, Mid1, Mid2, High and Auto.
  4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
  5. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
  6. The indoor unit shall have switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.
  7. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
  8. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.
- 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 33 inches above the condensate pan.
  7. Both refrigerant lines to the indoor units shall be insulated.
- F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, and 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts.

G. Controls:

1. This unit shall use controls provided with a factory wall mounted thermostat.
2. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8 degree F dead band from set point.

2.4 MULTI-POSTION AIR HANDLING UNITS

A. General: The indoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. Both liquid and suction lines must be individually insulated between the outdoor and indoor units.

B. Unit Cabinet:

1. The indoor unit shall have a white, "flat screen" finish.
2. The drain and refrigerant piping shall be accessible from six (6) positions for flexible installation (right side, right back, and right bottom; and left side, left back, and left bottom).
3. The cabinet shall be supplied with a mounting plate to be installed onto a wall for securely mounting the cabinet.
4. The cabinet includes an "intelligent-eye" motion sensor capable of setting back the set point temperature for energy savings. This feature may be disengaged on the wireless remote controller.

C. Fan:

1. The evaporator fan shall be an assembly consisting of a direct-driven fan by a single motor.
2. The fan shall be statically and dynamically balanced and operate on a motor with permanent lubricated bearings.
3. An auto-swing louver for adjustable air flow (both vertically and horizontally) is standard via the wireless remote control furnished with each system.
4. The indoor fan shall offer a choice of five speeds, plus quiet and auto settings.

D. Filter:

1. The return air filter provided will be a mildew proof, removable and washable filter. Optional photo catalytic, air purifying filters are available.

E. Coil:

1. The evaporator coil shall be a nonferrous, aluminum fin on copper tube heat exchanger.
2. All tube joints shall be brazed with silver alloy or phoscopper.
3. All coils will be factory pressure tested.
4. A condensate pan shall be provided under the coil with a drain connection.

F. Electrical:

1. The outdoor unit shall be powered with 208-230 volts, 1 phase, and 60 hertz power. The indoor unit shall receive 208-230 volt, 1 phase, 60 hertz power from the outdoor unit.
2. The allowable voltage range shall be 187 volts to 253 volts.

G. Control:

1. This unit shall use controls provided with a factory wall mounted thermostat.
2. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8 degree F dead band from set point.

H. Sound:

1. Indoor unit sound levels shall not exceed:

I. Controls:

1. This unit shall use controls provided with a factory installed third party thermostat interface to perform functions necessary to operate the system.
2. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8 degree F dead band from set point.

2.5 HIGH STATIC, CEILING-CONCEALED DUCTED INDOOR UNIT

A. General:

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, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

B. Unit Cabinet:

1. The cabinet shall be ceiling-concealed, ducted with a fixed rear return and a horizontal discharge supply.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

C. Fan:

1. Indoor unit shall feature adjustable external static pressure settings up to 1.00 in. WG.
2. The indoor unit fan shall be an assembly with one or two statically and dynamically balanced Sirocco fan(s) direct driven by a single motor with permanently lubricated bearings.

D. Filter:

1. Return air shall be filtered by a field-supplied filter.

E. Optional Filter Frame and Filter

1. Filter frame shall be constructed of 20 gauge G-60 galvanized steel. Knurled thumb screws on access door allow filter replacement. Foam gasket provides air-tight connection to indoor unit and access door. Filter frame shall be configurable for rear or bottom return.
2. Filter shall be rated MERV 13 when tested in accordance with ANSI/ASHRAE 52.2 Standard Rated Class 2 under U.L. Standard 900.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
2. The coils shall be pressure tested at the factory.
3. Coil shall be provided with a sloped drain pan. Units without sloped drain pans which must be installed cockeyed to ensure proper drainage are not allowed.

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. 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.
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.

2.6 BOOSTER HYDRONIC HEAT EXCHANGER

A. General:

1. The indoor unit shall consist of a floor-standing indoor section with a modulating linear expansion device, two brazed plate refrigerant to water heat exchangers, and a sealed R-134a internal refrigerant circuit. The unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, heat exchangers, R-134a refrigerant circuit, and control circuit board. 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.

B. Unit Cabinet:

1. The casing shall have a galvanized sheet metal finish.

C. Heat Exchanger:

1. The dual brazed plate heat exchanger setup with the internal R-134a circuit shall be capable of providing water up to 160°F.

D. Strainer:

1. The unit shall be provided with a Y-Strainer to be installed on the water inlet.

E. Piping:

1. The tubing shall have inner grooves for high efficiency heat exchange.
2. All tube joints shall be brazed with phos-copper or silver alloy.
3. The coils shall be pressure tested at the factory.

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. The unit shall have the capability of interlocking operation with water side circulator.
2. The unit shall have the capability of selecting inlet or outlet water temperature as controlled variable.
3. The unit shall have the capability of automatically resetting control target based on outdoor air temperature.
4. The unit shall have the capability of manually resetting control target from a remote source signal

2.7 TEMPERATURE CONTROL SYSTEM

A. Overview

1. Provide a web-based control system with network, system shall include the ability to allow web based interface for activate control monitoring and adjustments as well as monitoring of system energy usage.
2. The control system shall consist of a low voltage communication network and a web-based interface. The controls system shall gather data and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
3. Furnish energy conservation features such as optimal start, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.
4. System shall be capable of email generation for remote alarm annunciation.
5. Refer to Section 23 09 00 Temperature controls for specific temperature control sequences.

B. Electrical Characteristics

1. Controller power and communications shall be via a common non-polar communications bus and shall operate at 30VDC.
2. Wiring:
  - a. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
  - b. Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.



3. Wiring type:
  - a. Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.
  - b. Network wiring shall be CAT-5 with RJ-45 connection.

C. Simple MA Remote Controller:

1. For each fan coil provide a Backlit Simple MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group).
2. The Backlit Simple MA Remote Controller shall only be used in same group with Wireless MA Remote Controllers or with other Backlit Simple MA Remote Controllers, with up to two remote controllers per group.

<b>Simple MA Remote Controller</b>			
<b>Item</b>	<b>Description</b>	<b>Operation</b>	<b>Display</b>
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Operation Mode	Switches between Cool/Drying/Auto/Fan/Heat/Setback. Operation modes vary depending on the air conditioner unit. Auto and Setback mode are available for the R2/WR2-Series only.	Each Group	Each Group
Temperature Setting	Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit.  Separate COOL and HEAT mode set points available depending on central controller and connected mechanical equipment.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Group	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *1: Centrally Controlled is displayed on the remote controller for prohibited functions.	N/A	Each Group *1
Display Indoor Unit Intake Temp	Measures and displays the intake temperature of the indoor unit when the indoor unit is operating.	N/A	Each Group
Display Backlight	Pressing the button lights up a backlight. The light automatically turns off after a certain period of time. (The brightness settings can be selected from Bright, Dark, and Light off.)	N/A	Each Unit
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed	N/A	Each Unit
Test Run	Operates air conditioner units in test run mode. *2 The display for test run mode will be the same as for normal start/stop (does not display “test run”).	Each Group	Each Group *2
Ventilation Equipment	Up to 16 indoor units can be connected to an interlocked system that has one HRU unit.	Each Group	N/A

Simple MA Remote Controller			
Item	Description	Operation	Display
Set Temperature Range Limit	Set temperature range limit for cooling, heating, or auto mode.	Each Group	Each Group

D. City Multi Controls Network

1. The CITY MULTI Controls Network (CMCN) consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The CITY MULTI Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces. The below figure illustrates a sample CMCN System Configuration.

E. Centralized Controller (Web-Enabled)

1. Master Centralized Controller:

- a. The Master Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple CITY MULTI outdoor units with the use of three expansion controllers. The Master Centralized Controller shall be approximately 11-5/32" x 7-55/64" x 2-17/32" in size and shall be powered with an integrated 100-240 VAC power supply. The Master Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the Master Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the Master Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, fan speed setting, and airflow direction setting. Since the master provides centralized control it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the Master Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

Master Centralized Controller			
Item	Description	Operation	Display
ON/OFF	Run and stop operation.	Each Block, Group or Collective	Each Group or Collective
Operation Mode	Switches between Cool/Dry/Auto/Fan/Heat. (Group of HRU unit: automatic ventilation/vent-heat/interchange/normal ventilation) Operation modes vary depending on the air conditioner unit. Auto mode is available for the R2/WR2-Series only.	Each Block, Group or Collective	Each Group

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<b>Master Centralized Controller</b>			
<b>Item</b>	<b>Description</b>	<b>Operation</b>	<b>Display</b>
Temperature Setting	Sets the temperature from 57°F – 87°F depending on operation mode and indoor unit.	Each Block, Group or Collective	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Block, Group or Collective	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model. *1. Louver cannot be set.	*1 Each Block, Group or Collective	Each Group
Schedule Operation	Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available. *1. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority.  Twenty-four events can be scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition.  Five types of weekly schedule (seasonal) can be set.  Settable items depend on the functions that a given air conditioning unit supports.	*2 Each Block, Group or Collective	Each Group
Optimized Start	Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.	Each Block, Group or Collective	Each Block, Group or Collective
Night Setback Setting	The function helps keep the indoor temperature in the temperature range while the units are stopped and during the time this function is effective.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *3. Centrally Controlled is displayed on the remote controller for prohibited functions.	Each Block, Group or Collective	*3 Each Group
Room Temp	Displays the room temperature of the group. Space temperature displayed on the indoor unit icon on the touch screen interface.	N/A	Each Group

Master Centralized Controller			
Item	Description	Operation	Display
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed *4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection	N/A	*4 Each Unit or Collective
Outdoor Unit Status	Compressor capacity percentage and system pressure (high and low) pressure (excludes S-Series)	Each ODU	Each ODU
Connected Unit Information	MNET addresses of all connected systems	Each IDU, ODU and BC	Each IDU, ODU and BC
Ventilation Equipment	This interlocked system settings can be performed by the master system controller.	Each Group	Each Group
Multiple Language	Other than English, the following languages can be selected: Spanish, French, Japanese, Dutch, Italian, Russian, Chinese, and Portuguese.	N/A	Collective
External Input / Output	By using accessory cables you can set and monitor the following. Input By level: "Batch start/stop", "Batch emergency stop" By pulse: "batch start/stop", "Enable/disable remote controller" Output: "start/stop", "error/Normal" *5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.	*5 Collective	*5 Collective

- b. All Master Centralized Controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three expansion controllers for display of up to two hundred (200) indoor units on the main master centralized controller interface.
- c. The Master Centralized Controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.
- d. Standard software functions shall be available so that the building manager can securely log into each master centralized controller via the PC's web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Additional optional software functions of personal browser for PCs and MACs and Energy shall be available but are not included. The Energy Apportionment function shall require a LIC-Charge software license

F. Graphical User Interface

1. The Graphical User Interface (Integrated Centralized Control Web) shall require a field supplied PC or Tablet. Contractor to integrate into campus computer
2. ICCW
  - a. The Integrated Centralized Control Web System (ICCW) interface shall enable the user to control multiple networked central controllers and shall provide additional functions such as energy apportionment from a single network PC configured with the Charge Calculation Tool. The ICCW shall be capable of controlling up to forty networked Centralized Controllers with a maximum of 2,000 indoor units across multiple CITY MULTI outdoor units. The ICCW shall be required if the user wants to simultaneously control more than 1 Centralized Controllers from a single PC or tablet using a single web browser session. Licensing per function, per Centralized Controller shall be required for the ICCW. Optional software features shall be available through the ICCW including energy apportionment and personalized web. These optional software features shall require the ICCW, advance purchase from the customer, and licensing from ICCW.

<b>ICCW (Integrated System Software)</b>	
<b>Item</b>	<b>Details</b>
ON/OFF	The units can turn ON and OFF for all floors or in a block, floor, or group of units.
Operation Modes	The operation mode can be switched between COOL, DRY, FAN, AUTO, and HEAT for all floors or in a block, floor, or group of units
Temperature Setting	Sets the temperature for a single group. Range of Temperature setting from 57°F – 87°F depending on operation mode and indoor unit model. Separate COOL and HEAT mode set points available depending on remote controller and connected mechanical equipment.
Fan Speed	The fan speed can be set to four stages for all floors or in a block, floor, or group of units
Air Direction	The air direction can be set in four vertical directions or to swing for all floors or in block, floor, or group of units. (The selectable air direction differs according to the model.)
Interlocked Unit ON/OFF HRU	HRU ON or OFF for all floors or in a block, floor, or group of units. (Note that the ventilation mode cannot be selected for interlocked units.)
Local Operation Prohibit	The items for which operation with the local remote controller are to be prohibited can be selected for all floors or in a block, floor, or group of units. (The items that can be prohibited are ON/OFF, operation mode, set temperature and filter sign reset.)
Annual / Weekly Schedule	The annual/weekly schedule function can be used by registering the license. Two settings, such as seasonal settings for summer and winter, can be saved.
Power Rate Apportionment Charging	A watt-hour meter (WHM) with kWh pulse output is connected to calculate the air conditioning charges based on the amount each tenant's air-conditioner has operated. Five charging rates can be applied per day. PROVIDE OPTIONAL ENERGY APPORTIONMENT SOFTWARE (LIC-CHARGE) and PI Controller (PAC-Y60MCA)
History	Up to 3,000 items for the error history and up to 10,000 items for operation history can be saved. Each history file can be output as a daily report or monthly report in CSV format. (The operation history consists only of the operations carried out with the ICCW and is limited to some limited operation items.)
Operation Time Monitor	The cumulative operation time of each indoor unit can be viewed or output as a CSV format file. (This function is valid only when the charging function license is registered.)
Filter Sign Display	The filter sign display at the remote controllers can be disabled.

ICCW (Integrated System Software)	
Item	Details
Mask	
Set Temperature Limit	The set temperature lower limit can be set for cooling and the upper limit for heating. (ME remote controller required)

G. Energy Appointment Monitoring for City Multi Centralized Controllers

1. System Overview
  - a. The shall take the information on the electrical energy usage gathered from Watt Hour Meters (WHM). Provide current sensors connected to dedicated breaker panels serving the system's outdoor units and synthesize the information on the operating status of the indoor units collected by the CITY MULTI centralized controller(s).
2. Watt Hour Meters
  - a. The Watt Hour Meters (WHMs) to be used to read the electrical energy consumption of the outdoor units must shall be capable of a pulse output, which would be configured based on the current rating of the units. The associated current transformers/ transducers (CTs) must be sized based on the current rating of either the individual outdoor units or the dedicated air conditioning electrical panels they are to be reading. The proper quantity of meters for a particular sized system must be provided to ensure sufficient resolution and hysteresis in the unit pulse output of the meters so as to ascribe an acceptable level of accuracy to the apportionment of energy usage for each tenant's system. The system shall be designed to work with any WHM capable of a pulse output that meets ANSI C12.20 class 0.2% or 0.5% accuracy standards.
3. Connection:
  - a. The WHMs are to be physically connected to the integrated pulse input module or an external Mitsubishi Electric PI Controller. The cable type of the interconnecting wiring shall be according to the wiring specifications of the WHM manufacturer.

H. CITY MULTI Centralized Controller Requirements

1. Licensing:
  - a. Each centralized controller to which units shall be provided with required licensed software in order to enable the operating status of the indoor units to be passed to the energy apportionment tool.

**PART 3 - EXECUTION**

3.1 INSTALLATION

- A. Install conditioning systems in accordance with the manufactures' published instructions.
- B. Start and Commission system using factory Start-up technicians.

3.2 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to allow service and maintenance.
- D. Drainage Connections: Provide condensate drain piping for all indoor evaporators.
- E. Refrigerant Piping: Comply with applicable requirements in Division 23 Section "Refrigerant Piping." Provide shutoff valves and piping.

### 3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  - 2. After installing units and after electrical circuitry has been energized, test for compliance with requirements.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. After startup service and performance test and change filters.

### 3.4 ADJUSTING AND FOLLOW-UP TESTING AND ADJUSTMENTS

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 3 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two 8 hour visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 23 81 23

## SECTION 26 0010 ELECTRICAL GENERAL PROVISIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. This Section specifies provisions for electrical work, including: certain adaptive expansions of requirements specified in Division 1, General Requirements for the electrical systems as a whole, and work to be performed as electrical work, because of its close association.

B. Related Sections include the following:

1. The general provisions of the Contract, including the General, Supplementary, and Special Conditions and the General Requirements apply to the work specified in all sections of this Division.

#### 1.2 SUMMARY OF ELECTRICAL WORK

A. The work required of this Division shall include all labor, materials, equipment, plant, transportation, and all necessary and related items required to provide complete and satisfactory operating electrical systems for the project. The work in general consists of additions and alterations to the existing electrical systems, including but not limited to the following:

1. Reuse of existing work.
2. Electrical underground line extension, electrical service entrance and coordination with the electric utility
3. Power distribution system, feeders and equipment
4. Branch circuits to all electrical equipment
5. Lighting system, luminaires and accessories
6. Lighting control systems
7. Final connections to all electrical equipment furnished by this Division and by other Divisions.
8. Grounding and bonding
9. Wiring devices, raceways, boxes and fittings
10. Electrical power and energy monitoring system
11. Electric vehicle charging stations
12. Fire alarm system
13. Elevator call system
14. Boxes, pathways, cabling for access control and security
15. Telecommunications horizontal wiring systems
16. Temporary light and power for construction



17. Receiving, handling and storage of all equipment required of this Division
18. Mounting of equipment furnished by other trades, if so designated
19. Start-up of electrical systems and equipment
20. Coordination with the Commissioning Agent
21. The final testing and adjustment of all electrical systems and equipment to demonstrate proper function, control and interlock.
22. All minor and related items and accessories to each make each system complete in all respects.

B. Contract Drawings for Electrical Work are in part diagrammatic, intended to convey scope of work and indicate the general arrangement of equipment. Electrical trade shall follow these Drawings in laying out their work, consult General Construction Drawings to familiarize themselves with conditions affecting their work, and shall verify spaces in which their work will be installed by measurements on the job. DO NOT SCALE DRAWINGS.

C. Refer to the Division 26 Sections for the primary technical specifications of electrical work. Refer to the Division 27 and 28 sections for the primary technical specifications of communications and electronic safety systems work.

D. Any discrepancy between any Drawings, Details and/or Specifications must be promptly submitted to the Architect for determination. Any adjustment by the Contractor without determination will be at the Contractor's own risk and expense.

E. Each bidder shall carefully examine all of the Contract Documents and shall submit written requests for clarification of all discrepancies between, or meaning of the various parts of the documents in compliance with the bidding instructions. All clarifications will be issued by written addenda. Failure to request clarifications during bidding shall not entitle the Contractor to additional compensation for performing the work in accordance with the Contract Documents as interpreted by the Architect.

### 1.3 PERMITS AND CODES

A. Unless specified otherwise this Contractor shall obtain and pay for all licenses and permits and shall pay for all fees and charges for the connection to outside services and for use of property other than the site of work for storage of materials and other purposes.

1. Electric utility costs shall be paid directly, by the Owner

B. In addition to the requirements in Section 01 6000, all work shall comply with the latest edition, in effect at time of construction, of the following codes, rules, laws and regulations:

ADA	Americans with Disabilities Act
ANSI	American National Standards Institute
ASTM	American Society of Testing Materials
BOCA	Building Officials and Code Administration, including supplements
IEEE	Institute of Electrical and Electronic Engineers

IPCEA	Insulated Power Cable Engineers Association
NEMA	National Electrical Manufacturers Association
NEC	National Electrical Code (NFPA No. 70)
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Act
UL	Underwriters Laboratories

State and Local Laws and Regulations

- C. Obtain and pay for State of Vermont Certificate of Inspection and Approval.

1.4 WORK EXCLUDED, PROVIDED UNDER OTHER SECTIONS

- A. All general conditions work shall be coordinated and provided by the Construction Manager unless specifically identified otherwise by the Construction Manager. This work includes concrete, wood, metals, painting, penetrations and similar. Any questions shall be coordinated with the Construction Manager during bidding.
- B. Excavation and Backfill: Refer to Division 31, Earthwork. Coordinate work of this section with excavation and backfill work.
- C. Concrete Work: Refer to Division 03, Concrete General. Coordinate work of this Section with concrete work. Provide size, layout, location and accessories for bases required for equipment as indicated on the Drawings.
- D. Equipment Backboard: Equipment backboards shall be provided under Division 06, Wood, Plastics and Composites in the Rough Carpentry section. Coordinate size required. Do not install electrical equipment on backboard until board has been painted. Paint shall be gray. Do not paint over fire resistance labeling.
- E. Finished Painting: All finished painting shall be provided under Division 09. Electrical contractor shall include the restoration of manufacturers finish paint damaged during shipment, installation or temporary use to original condition prior to finish painting.

1.5 WORK AND MATERIALS SPECIFIED ELSEWHERE

- A. Equipment, materials and work requiring electric service and specified in other Divisions include, but are not limited to:
  - 1. Air moving equipment
  - 2. Condensing Units
  - 3. Temperature control system
  - 4. Heating equipment
  - 5. Fire suppression systems
  - 6. Variable frequency drives
  - 7. Appliances

8. Elevator

1.6 SPECIAL WIRING REQUIREMENTS

- A. In addition to the general requirements of compliance with the applicable Codes, Rules and Regulations of the Town of Putney and the State of Vermont, the work requires special wiring methods including, but not limited to, the following:

1. Emergency/Standby Power System:	NFPA 110, NEC 700/701
2. Elevator	ANSI A17.1, NEC 620
3. Raceway Seals:	NEC 300
4. Appliances:	NEC 422
5. Motors, Motor Circuits & Controllers:	NEC 430
6. Fire Alarm System	NEC 760

1.7 TEMPORARY POWER AND LIGHT

- A. Coordinate work requirements of this section to provide a system of temporary power and light for the project and as follows:

1. Provide, connect and terminate temporary power and light facilities as determined by the Construction Manager at locations required during construction.
2. Temporary lighting for all construction areas of the project including wiring, fixtures and controls.
3. Temporary power outlets for the purpose of supplying connections for construction tools and machines, and temporary plumbing and heating equipment.
4. All equipment installation and wiring shall comply with applicable sections of this specification, provide overload protection, disconnect switches and devices as required with ground fault protection.
5. Do not subject temporary electrical facilities to higher demand or loading than designed for.
6. When no longer needed for construction work, remove electrical temporary facilities. Repair and restore work damaged by installation and operation of electrical temporary facilities. Clean and restore permanent electrical systems which have been used to provide temporary services, to the condition of new and unused work except for normal wear.
7. Electrical work installed as temporary facilities shall, upon removal, remain the property of the Installer.

1.8 COORDINATION OF ELECTRICAL INSTALLATION

- A. Sequence, coordinate and integrate the various elements of electrical work so that the electrical system will perform as indicated and be in harmony with the other work of the building. The

Engineer will not supervise the coordination, which is the exclusive responsibility of the Contractor. Comply with the following requirements:

1. Install conduit, cables wireways and similar services straight and true, aligned with other work, close walls and overhead structure, concealed where possible in occupied spaces, and out-of-way with maximum passageway and headroom remaining in each space.
  2. Except as otherwise indicated, arrange electrical services and overhead equipment with a minimum of 7'-0" headroom in storage spaces and 8'-6" headroom in other spaces. Keep services as high as possible where higher spaces occur.
  3. Arrange work to facilitate maintenance and repair or replacement of equipment. Locate services requiring maintenance on wiring devices and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work. Locate operating and control equipment and devices for easy access.
  4. Install access panels where electrical work requiring access is concealed by finishes and similar work.
  5. Integrate electrical work above ceilings, including lighting fixtures, with ceiling finish, suspension, ductwork, air diffusers and other work, so that required performance of each will be achieved.
  6. Give the right-of-way in confined-service spaces to piping which must slope for drainage, and to ductwork and similar services which are less conformable than electrical services.
- B. Conform with the shop drawings including the coordination drawings, to the greatest extent possible. Conform to the arrangement indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, comply with the Engineer's decision on resolution of the conflict.
- C. Coordinate the electrical work with the mechanical work for proper service to each item of equipment requiring electrical connection. Determine, with each mechanical equipment installer, the proper sequencing and location for disconnect switches and similar points of interface between mechanical and electrical work. Do not block equipment access doors or other points of access with electrical work and provide adequate clearance for filter changes and other routine maintenance to be performed. Except as otherwise indicated, the final connections are electrical work.
- D. Adjust and coordinate the timing of electrical system start-ups with mechanical system start-ups so that demonstration and testing of specified performance can be observed and recorded. Exercise proper care in off season start-ups, to ensure that systems and equipment will not be damaged by the operation.

## 1.9 SUBMITTALS

- A. Prepare electrical shop drawings to accurate scale except where diagrammatic representations are specifically indicated. Show clearance dimensions of critical locations, and show dimensions of spaces required for operating and maintenance of equipment. Show conduit and conductor

connections and other service connections, and show interfaces with other work including structural support.

- B. Where printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy to indicate which of the variations is to be provided. Delete or mark-out portions which are not applicable. Where operating ranges are shown, mark data to show portion of range required for project application. For each product include the manufacturer's specifications, installation or fabrication instruction, sizes, weights, speeds, operating capacities, conduit and wire connection sizes and locations.
- C. Items to be submitted are as follows:
  - 1. Name, address, list of similar projects completed, qualifications, and at least three (3) references for the Electrical Subcontractor proposed to perform the electrical work.
  - 2. Catalog cuts and shop drawings of all materials and equipment, as listed herein.
  - 3. Installation instructions and Operation and Maintenance Manuals for all equipment.
  - 4. List of nameplate designations for Engineer's acceptance, prior to engraving.
  - 5. Copies of all required Permits.
  - 6. Duplicate copies of electrical inspection certificates.
  - 7. Complete listing of all tests performed and copies of the certified test results.
  - 8. "As-Built" wiring diagrams and circuit directories.
- D. Equipment Submittals: Refer to other sections of this division for required submittals as well as the plan notes for additional, specific product information required to be submitted for approval.

#### 1.10 MATERIALS SUBSTITUTIONS

- A. Comply with the requirements of Division 01, General Requirements and requirements of Division 26 sections, as applicable.
- B. Substitute materials and equipment, where requested or proposed by Contractor, shall be itemized and shall show cost to Owner whether it be a "deduction" or "no change in cost" to the Base Bid Price. The contractor is to coordinate with all other trades on requirements of the substitution and shall bear all additional cost associated with the substitution. It shall be held that no change in Contract completion time will occur should Engineer elect to accept any alternates unless such time is specifically stated in the Contractor's Bid.
- C. In substitution of other makes for those items which are specified, only those requiring minor deviations in details from those specified will be considered, and any make which requires major changes in the design and structural elements of building will not be considered. In any event, the Engineer reserves the right to refuse to accept any substitute for the make specified.
- D. Uniformity, unless otherwise specified, equipment of materials of same type of classifications shall be used for same purpose and shall be the product of same manufacturer.

- E. Materials, equipment and products not approved shall not be used in construction.

#### 1.11 ELECTRICAL WORK CLOSEOUT

##### A. Record Drawings:

1. Except where otherwise indicated, Electrical Drawings prepared by Engineer are diagrammatic in nature and may not show locations accurately for various components of electrical systems. Shop drawings (including coordination drawings) prepared by Contractor show certain portions of work more accurately to scale and location, and in greater detail. It is recognized that actual layout of installed work may vary from both Contract Drawings and shop drawings.
2. Maintain a white-print set (blue-line or black-line) of electrical contract drawings and shop drawings in clean, undamaged condition, for mark-up of actual installation which vary from the work as shown. Mark-up whatever drawings are most capable of showing installed conditions accurately. Where shop drawings are marked, record a reference note on appropriate contract drawings. In general, record every substantive installation of electrical work which previously is either not shown or shown inaccurately, but in any case, record the following:
  - a. Work concealed behind or within other work, in a non-accessible arrangement.
  - b. Panelboards and control devices located and numbered, and devices requiring maintenance located.
  - c. Sensor and signal locations of alarm systems and controls.
3. Maintain Record Drawings up to date in a timely fashion. Record drawing mark-ups may be reviewed monthly by the Construction Manager/Owner prior to authorizing payment of the requisition.

##### B. Test, Adjustments, Cleaning and Lubrication:

1. Provide system performance test runs. Coordinate test runs of electrical systems with test runs of equipment served thereby (heating, air conditioning, plumbing, etc.). Check each item in each system to determine that it is set for proper operation. With Owner's Representative and Engineer present, operate each system in a test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of systems to refine and improve performances where possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be reasonably requested for Engineer's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible.
2. After final performance test run of each electrical system, clean system both externally and internally. Comply with manufacturer's instructions for lubrication of both power

and hand operated equipment, and remove excess lubrication. Touch-up minor damage to factory painted.

1.12 DEFINITIONS

- A. Except as specifically defined otherwise, the following definitions supplement definitions of the Contract, General Conditions and Supplementary Conditions and apply generally to the Work.
- B. Indicated: Shown on Drawings by notes, graphics or schedules, or written into other portions of Contract Documents. Terms such as "shown", "noted", "scheduled" and "specified" have same meaning as "indicated", and are used to assist the reader in locating particular information.
- C. Project Site: Space available to Contractor at location of project, either exclusively or to be shared with separate contractors, for performance of the Work.
- D. Furnish: Supply and deliver to project site, ready for unloading, unpacking, assembly, installation and similar subsequent requirements.
- E. Install: Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar requirements.
- F. Provide: Furnish and install, complete and ready for intended use.
- G. Installer: Entity (firm or person) engaged to install work, by Contractor, Subcontractor or Sub-subcontractor.

1.13 MEANS AND METHODS

- A. Unless otherwise expressly provided in the Contract Documents the means and methods of construction, including all safety procedures, shall be such as the Contractor may choose, subject however, to the Engineer's right to reject means and methods proposed by the Contractor which: (1) will constitute or create a hazard to the work, person(s) or property or (2) will not produce finished work in accordance with the terms of the Contract. The right to reject shall not, in any way, be construed or interpreted as acceptance or control of means and methods by the Engineer and/or his representative.
- B. The Engineer's rejection of the Contractor's means and methods of construction, or the Engineer's failure to exercise his right to reject such means or methods, shall not relieve the Contractor of his obligation to accomplish the result intended by the Contract: nor shall the retention of such right-to-reject create a cause of action for damages due to exercise, or failure to exercise, such rights.

1.14 GUARANTEE, SERVICE AND REPLACEMENT

- A. Except as a longer period may be provided in this specification, this Contractor shall guarantee the work to the full extent of the provision of the Drawings, this specification and the General Conditions for a period of one (1) year from the date of acceptance by the Architect as evidenced by the Architect's Final Certificate.
- B. This Contractor shall service all installed equipment free of charge during the guarantee period.
- C. Any apparatus or equipment that requires excessive service during the guarantee period shall be considered defective and shall be replaced by this Contractor without additional cost to Owner.

1.15 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered to the site and stored in factory fabricated containers.
- B. All materials shall be stored in interior spaces protected from weather, dirt and construction traffic, except the materials that are not affected by exposure to the weather may be stored outside if elevated above grade and enclosed in a durable, waterproof wrapping.
- C. Handle all materials carefully to avoid damage to equipment or finish. Do not install damaged equipment, remove from site.
- D. Each Contractor or his representative shall visit the site prior to bidding and make an estimate of facilities and difficulties attending execution of their work. No claims will be allowed because of discrepancies in such estimates.

1.16 INSTALLATION – GENERAL

- A. All applicable equipment shall be U.L. Listed and shall be installed in accordance with U.L., NEMA, NFPA, NEC and IPCEA Standards.
- B. All equipment shall be installed plumb, both vertically and horizontally, presenting a neat finished appearance.
- C. All equipment, boxes, cables and raceways shall be securely fastened to building structure in accordance with NEC requirements.
- D. All panelboards and group mounted equipment (starters, disconnect switches, etc.) to be surface mounted shall be installed on plywood backboards. Backboards shall be painted before installation of equipment.
- E. Install equipment in accordance with manufacturers written instructions, at locations indicated, fully coordinated with work and equipment to be installed by others.



- F. Location of outlets shall be generally as shown on the Drawings. Field coordinate with requirements of ceilings, furniture and equipment. Locate switches on strike side of doors and locate device outlets centered on masonry block or other regular or patterned building finishes. Make minor adjustments to outlet locations as directed, prior to rough-in, at no extra cost.

1.17 QUALITY ASSURANCE – GENERAL

- A. Manufacturers shall be firms regularly engaged in the manufacture of electrical products of the types and ratings required, whose products have been in satisfactory use in similar service for not less than three (3) years.
- B. Installer shall be a firm with at least three (3) years of successful installation experience on projects with electrical installation work similar to that required for the project.
- C. Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical systems.
- D. Provide electrical equipment which has been listed and labeled by Underwriter's Laboratories, where applicable.
- E. Comply with National Electrical Manufacturers Association Standards publications pertaining to materials, construction and testing, where applicable.

1.18 ALTERNATES

- A. There are alternates which affect the electrical work of this project. In general, drawings indicate full build-out of the project.
- B. Refer to Division 1 specifications and bidder instructions for additional, related information.
- C. Alternates to the project which affect electrical work are as follows:
  - 1. Welch Faculty Residence fit-up – Base bid, the faculty residence shall be constructed core and shell, with minimal electrical installed. Alternate will be full fit up of the Welch Faculty Residence as indicated on plan drawings. Under the base bid, provide the following:
    - a. Conduit with pullwire from panelboard MDPW underslab and stubbed up at the panelboard FRWS location, for future use.
    - b. Conduit with pullwire from telecom backboard underslab and stubbed up in corner of closet, for future use.
    - c. 1" Conduit with pullwire from telecom backboard underslab and stubbed up in corner of closet, for future use.
    - d. 1.5" Conduit with pullwire from panelboard SBW underslab and stubbed up adjacent to panelboard FRWS, for future electric heat power use.

2. Kilton Faculty Residence A fit-up – Base bid, the faculty residence shall be constructed core and shell, with minimal electrical installed. Alternate will be full fit up of the Welch Faculty Residence as indicated on plan drawings. Under the base bid, provide the following:
  - a. Conduit with pullwire from panelboard MDPK underslab and stubbed up at the panelboard FRKS location, for future use.
  - b. Conduit with pullwire from telecom backboard underslab and stubbed up at the media box location, for future use.
  - c. 1" Conduit with pullwire from telecom backboard underslab and stubbed up in corner of closet, for future use.
  - d. 1.5" Conduit with pullwire from panelboard SBK underslab and stubbed up adjacent to panelboard FRKS, for future electric heat power use.
  
3. Kilton Faculty Residence B fit-up – Base bid, the faculty residence shall be constructed core and shell, with minimal electrical installed. Alternate will be full fit up of the Welch Faculty Residence as indicated on plan drawings. Under the base bid, provide the following:
  - a. Conduit with pullwire from panelboard MDPK underslab and stubbed up at the panelboard FRKN location, for future use.
  - b. Conduit with pullwire from telecom backboard underslab and stubbed up at the media box location, for future use.
  - c. 1" Conduit with pullwire from telecom backboard underslab and stubbed up in corner of closet, for future use.
  - d. 1.5" Conduit with pullwire from panelboard SBK underslab and stubbed up adjacent to panelboard FRKS, for future electric heat power use.
  
4. Existing Welch Renovation / Upgrades – Base bid, the existing faculty residence shall generally remain as it exists, with minimal electrical modifications. Alternate will be the renovations to the existing Welch Faculty Residence as indicated on plan drawings. Under the base bid, provide the following:
  - a. Provide new feeder to existing panelboard FRWN from panelboard MDPW.
  - b. Remove existing fire alarm system, devices, wiring and replace with new system smoke detectors and system smoke/carbon monoxide sensors connected to the new Welch Dormitory fire alarm system panel.
  
5. Existing Kilton Dormitory Lighting Replacement – Base bid, the lighting and controls in the existing dormitory rooms 105, 106, 107, 208, 209, 210, 211 and bathrooms 121, 216 remains as it exists. Alternate shall be providing new lighting and controls in those rooms as indicated on the plan drawings.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 RENOVATION AND DEMOLITION WORK, AS APPLICABLE

- A. Refer to contract Drawings and notes for information specific to renovation and/or demolition.
- B. The Contractor shall remove all wiring devices, luminaires etc., which are indicated to be removed or in areas where new devices are shown. Devices, which are to be removed, may require reworking conduit and wiring in order to maintain service to other devices. If removed devices are flush or semi-flush in walls or ceilings that are to remain, blank coverplates are to be installed on outlet boxes. Where renovation interferes with circuits in areas, which are otherwise undisturbed, circuits shall be reworked as required. Existing devices and circuiting, which are shown, are indicated only for informational purposes. The Contractor shall visit the site and shall verify conditions as they exist and shall remove, relocate and/or rework any electrical equipment or circuits affected (whether indicated or not) due to the removal or reworking of existing walls, ceilings, etc. The Contractor shall familiarize himself with all work to be done by other trades by studying the Architectural, Structural, Mechanical and Plumbing Drawings. Coordinate the routing of all conduits with the Mechanical and Plumbing Contractors in order to avoid conflicts with ducts, pipes, etc.
- C. All equipment, fixtures, devices, etc., which are removed and designated as salvageable by the Owner, shall be delivered to the Owner for disposition. All items that are not reused shall become the property of the Contractor and shall be removed from the site.
- D. Existing Conduits, Pipes, Equipment, etc.:
  - 1. Refer to Division 1 for additional requirements. Existing conduits, pipes, utility lines, tanks, equipment or other obstructions, whether underground, concealed or exposed, are not generally indicated on the Drawings.
  - 2. Locate such obstructions prior to the start of the work and plan the work so as to route and locate all new work to avoid these obstructions.
  - 3. Repair or replace, at no cost to the Owner, the existing installations where damaged during the course of construction.
- E. All existing electrical equipment, such as luminaires, boxes, enclosures and panelboards, which are to be worked on or relocated under this Contract shall be cleaned and labeled to meet the requirements of this Specifications.
  - 1. Panelboards: Provide new nameplates, signs and directories.
- F. The Electrical Contractor shall be responsible for any temporary power wiring or electrical equipment arrangements to be made for the mechanical, plumbing or Owner's equipment that needs to be maintained on line during the construction phase.

End of Section 26 0010

## SECTION 26 0519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 26 0523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2 and 3 control cables.
2. Section 27 1500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

#### 1.2 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS AND CABLES

- A. Aluminum and Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2, Type XHHW-2 and Type SO.
- C. Multi-conductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC, nonmetallic-sheathed cable, Type NM, Type SO, Type SE and Type USE with ground wire.

#### 2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper or aluminum. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Feeders: Type XHHW-2, single conductors in raceway, or Metal-clad cable, Type MC, Nonmetallic-sheathed cable, Type NM.
- C. Branch Circuits: Type THHN-2-THWN-2, single conductors in raceway, or Metal-clad cable, Type MC, Nonmetallic-sheathed cable, Type NM.
- D. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 0533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- F. Support cables according to Section 26 0529 "Hangers and Supports for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 0553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 0544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 8413 "Penetration Firestopping."

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Test and Inspection Reports: Prepare a written report to record the following:
1. Procedures used.
  2. Results that comply with requirements.
  3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 0519

## SECTION 26 0523 CONTROL-VOLTAGE ELECTRICAL POWER CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Low-voltage control cabling.
  - 2. Control-circuit conductors.
  - 3. Identification products.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262 by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
  - 1. Flame Travel Distance: 60 inches (1520 mm) or less.
  - 2. Peak Optical Smoke Density: 0.5 or less.
  - 3. Average Optical Smoke Density: 0.15 or less.
- B. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- C. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

#### 2.3 LOW-VOLTAGE CONTROL CABLE

- A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
  - 1. One or Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
  - 2. PVC insulation.
  - 3. Unshielded.



4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

#### 2.4 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway, complying with UL 44.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway, complying with UL 44.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway, complying with UL 44.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 26 0533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
  1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.
  2. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:
  1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
  2. Install cable trays to route cables if conduits cannot be located in these positions.
  3. Secure conduits to backboard if entering the room from overhead.
  4. Extend conduits 3 inches (75 mm) above finished floor.
  5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1 and NFPA 70.

B. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems".
3. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, and patch panels.
4. Cables may not be spliced.
5. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems". Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Do not use heat lamps for heating.
9. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems". Monitor cable pull tensions.
10. Support: Do not allow cables to lie on removable ceiling tiles.
11. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 30 inches (760 mm) apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

D. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.

3.3 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.4 FIRESTOPPING

- A. Comply with TIA-569-B, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping" Chapter.

3.5 GROUNDING

- A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For low-voltage control wiring and cabling, comply with requirements in Section 26 0526 "Grounding and Bonding for Electrical Systems."

3.6 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

END OF SECTION 26 0523

## SECTION 26 0526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Burndy; Part of Hubbell Electrical Systems.
  - 2. Dossert; AFL Telecommunications LLC.
  - 3. ERICO International Corporation.
  - 4. Fushi Copperweld Inc.
  - 5. Galvan Industries, Inc.; Electrical Products Division, LLC.
  - 6. Harger Lightning and Grounding.
  - 7. ILSCO.
  - 8. O-Z/Gedney; A Brand of the EGS Electrical Group.
  - 9. Robbins Lightning, Inc.
  - 10. Siemens Power Transmission & Distribution, Inc.

#### 2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

#### 2.3 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

## 2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## 2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel: 3/4 inch by 10 feet (19 mm by 3 m).

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  1. Bury at least 24 inches (600 mm) below grade.
- C. Conductor Terminations and Connections:
  1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Pad-Mounted Transformers and Sectionalizing Cabinets: Provide grounding as per utility direction. At a minimum, install two ground rods around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for taps to equipment grounding terminals.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Metal-clad cable runs.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

END OF SECTION 26 0526

## **SECTION 26 0529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

**A. Section includes:**

1. Hangers and supports for electrical equipment and systems.

#### **1.2 PERFORMANCE REQUIREMENTS**

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For steel slotted support systems.

#### **1.4 QUALITY ASSURANCE**

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

### **PART 2 - PRODUCTS**

#### **2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS**

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.



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. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Atkore International.
    - g. Wesanco, Inc.
  2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  5. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, 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, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hilti, Inc.
      - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
  - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Cooper B-Line, Inc.
    - 2) Empire Tool and Manufacturing Co., Inc.
    - 3) Hilti, Inc.
    - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - 5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. 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.

1. Secure raceways and cables to these supports with single-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.

- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.

- C. 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. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

- D. 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:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Spring-tension clamps.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. 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. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 0529

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## SECTION 26 0533 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.
8. Two-part raceway sealants.

##### B. Related Requirements:

1. Section 26 0543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For two-part raceway sealants, surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

##### B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

##### C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. EMT: Comply with ANSI C80.3 and UL 797.
- D. FMC: Comply with UL 1; aluminum.
- E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  - 2. Fittings for EMT: Provide setscrew type, steel fittings for EMT, unless noted otherwise on the Electrical Construction Drawings.
  - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
  - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- G. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- C. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- D. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R or Type 4 unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Provide air tight vapor sealed boxes at all exterior walls and ceilings, below attic spaces and adjacent to unconditioned spaces.
- F. Metal Floor Boxes:
  - 1. Material: Cast metal or sheet metal.
  - 2. Type: Fully adjustable.
  - 3. Shape: Rectangular.
  - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).
  - 1. Listing and labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.



- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep).
- L. Gangable boxes are allowed.

## 2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
  - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
  - 1. Standard: Comply with SCTE 77.
  - 2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
  - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 5. Cover Legend: Molded lettering, "ELECTRIC" or "COMMUNICATION".
  - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

## 2.6 TWO-PART RACEWAY SEALANTS

- A. Description: Two part, high-expansion foam duct sealant.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product listed below or comparable product:
    - a. American Polywater Corporation – FST Foam Sealant
  - 2. Sealant: Two-part, urethane foam consisting of a resin and curing agent mixed within a caulking tube in a 1/1 ratio.
  - 3. Performance:
    - a. Meets National Electrical Code Articles 225.27, 230.8, and 300.5(G) "Raceway Seals"
    - b. Will hold 20' water-head pressure continuously; 70' water-head pressure intermittently

- c. Expands, cures and seals even with the presence of water
- d. Seal will tolerate cable movement
- e. Re-enterable; sealing shall be removable
- 4. Sealant system shall be UL recognized, passing UL 94 Class HBF fire retardant rating.
- 5. -20°F to 200°F continuous operating range; -40°F to 250°F peak
- 6. Sealant performance shall not be affected by sunlight exposure

### PART 3 - EXECUTION

#### 3.1 RACEWAY APPLICATION

- A. Apply raceway products as outlined in the General Notes on the Electrical Construction Drawings.
- B. Minimum Raceway Size: 1/2-inch (16-mm) trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. EMT: Use setscrew, steel fittings, unless otherwise noted on the Electrical Construction Drawings. Comply with NEMA FB 2.10.
  - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- E. Install surface raceways only where indicated on Drawings.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

#### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- H. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- K. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- M. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- N. Seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.

- O. Where raceways enter the building from underground, utilize a two-part raceway sealant. Sealant shall be installed in conduits upon completion of the installation of conductors in the raceway. Spare conduits shall be sealed upon installation.
- P. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m).
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
    - d. Attics: 135 deg F (75 deg C) temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F (0.06 mm per meter of length of straight run per degree C) of temperature change for PVC conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Q. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- R. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- S. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- T. Locate boxes so that cover or plate will not span different building finishes.
- U. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

- V. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- W. Set metal floor boxes level and flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 0544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 "Penetration Firestopping."

### 3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 0533

## SECTION 26 0543 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Direct-buried conduit, ducts, and duct accessories.
2. Concrete-encased conduit, ducts, and duct accessories.

B. Related Requirements:

1. Section 26 0533 "Raceways and Boxes for Electrical Systems" for underground raceway materials.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For ducts and conduits, duct-bank materials, manholes, handholes, and boxes, and their accessories.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:
  - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
  - b. Include duct entry provisions, including locations and duct sizes.
  - c. Include reinforcement and joint details, frame and cover design, and manhole frame support rings.
2. Precast transformer vault shall be submitted to the utility for their approval as part of the formal submittal process.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

A. Comply with ANSI C2.

#### 2.2 PRECAST STRUCTURES

A. Comply with ASTM C 858.

B. Structural Design Loading: Comply with requirements in "Underground Enclosure Application" Article.

- C. Windows: Precast reinforced openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
- D. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
- E. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.
- F. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

### PART 3 - EXECUTION

#### 3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank unless otherwise indicated.
- B. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank unless otherwise indicated.
- C. Underground Ducts Crossing Driveways and Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

#### 3.2 EARTHWORK

- A. Excavation and Backfill: Comply with Section 31 2000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 32 9200 "Turf and Grasses" and Section 32 9300 "Plants."
- C. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting and Patching" Article in Section 01 7300 "Execution."

#### 3.3 DUCT INSTALLATION

- A. Install ducts according to NEMA TCB 2.
- B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Installation Adjacent to High-Temperature Steam Lines: Where duct banks are installed parallel to underground steam lines, perform calculations showing the duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct bank crosses above an underground

steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 26 0544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- (450-N-) test nylon cord in empty ducts.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
  - 1. Refer to utility trench detail on drawings for minimum extents of concrete encasement.
  - 2. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
  - 3. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
  - 4. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
  - 5. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than four spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  - 6. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
  - 7. Elbows: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
  - 8. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
  - 9. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
  - 10. Concrete Cover: Install a minimum of 3 inches (75 mm) of concrete cover at top and bottom, and a minimum of 2 inches (50 mm) on each side of duct bank.



11. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

I. Direct-Buried Duct Banks:

1. Excavate trench bottom to provide firm and uniform support for duct bank. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches (150 mm) in nominal diameter.
2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
3. Space separators close enough to prevent sagging and deforming of ducts, with not less than four spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
4. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
7. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
  - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
8. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 31 2000 "Earth Moving" for installation of backfill materials.
  - a. Place minimum 3 inches (75 mm) of sand as a bed for duct bank. Place sand to a minimum of 6 inches (150 mm) above top level of duct bank.

- J. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

### 3.4 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

- A. Precast Concrete Handhole and Manhole Installation:
  - 1. Comply with ASTM C 891 unless otherwise indicated.
  - 2. Install units level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances.
  - 3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- B. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- C. Dampproofing: Apply dampproofing to exterior surfaces of manholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 071113 "Bituminous Dampproofing." After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

### 3.5 GROUNDING

- A. Ground underground ducts and utility structures according to Section 26 0526 "Grounding and Bonding for Electrical Systems."

### 3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
  - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch- (150-mm-) long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

### 3.7 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 0543

## SECTION 26 0544 SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.
6. Two-part duct sealants.

##### B. Related Requirements:

1. Division 07 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

#### 1.2 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

##### A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

##### C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
  - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
  - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. CALPICO, Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
    - e. Proco Products, Inc.
  2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Carbon steel.
  4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Presealed Systems.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
  - 2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
  4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.
- 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION
- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
  - B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- 3.3 SLEEVE-SEAL-FITTING INSTALLATION
- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
  - B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
  - C. Secure nailing flanges to concrete forms.
  - D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 0544



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## SECTION 26 0553 IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Identification for conductors.
2. Underground-line warning tape.
3. Warning labels and signs.
4. Instruction signs.
5. Equipment identification labels.
6. Miscellaneous identification products.

#### 1.2 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

- D. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## 2.2 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
  - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
  - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
  - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

## 2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
  - 1. Preprinted aluminum signs punched or drilled for fasteners, with colors, legend, and size required for application.
  - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
  - 3. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.4 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use

multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

- F. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

### 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

- 1. Generator Power.

- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

- 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

- a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

- b. Colors for 208/120-V Circuits:

- 1) Phase A: Black.
- 2) Phase B: Red.
- 3) Phase C: Blue.

- c. Colors for 240/120-V Circuits:

- 1) Phase A: Black.
- 2) Phase B: Red.

- d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

- C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

- D. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source.

- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
  4. Fire alarm boxes shall have red painted covers.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
  2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
  2. Identify system voltage with black letters on an orange background.
  3. Apply to exterior of door, cover, or other access.
  4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
- H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.
- J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
    - a. Indoor Equipment: Adhesive film label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label 4 inches (100 mm) high.
- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 26 0553

## SECTION 26 0923 LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Indoor occupancy and vacancy sensors.
4. Switchbox-mounted occupancy and vacancy sensors

##### B. Related Requirements:

1. Section 26 2726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.
2. Refer to the Automatic Lighting Control Performance Specification, Automatic Lighting Control Device Schedule and Lighting Control Schedule on the Drawings.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

##### B. Shop Drawings:

1. Show installation details for the following:
  - a. Occupancy sensors.
  - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

#### 1.3 CLOSEOUT SUBMITTALS

##### A. Operation and maintenance data.

#### 1.4 WARRANTY

- ##### A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.



1. Warranty Period: Two year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Cooper Industries, Inc.
  2. Intermatic, Inc.
  3. Leviton Manufacturing Co., Inc.
  4. NSi Industries LLC.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Contact Configuration: SPST.
  3. Contact Rating: 20-A ballast load, 120-/240-V ac.
  4. Programs: Four on-off set points on a 24-hour schedule.
  5. Astronomic Time: Selected channels.
  6. Automatic daylight savings time changeover.
  7. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

### 2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Cooper Industries, Inc.
  2. Intermatic, Inc.
  3. Leviton Manufacturing Co., Inc.
  4. NSi Industries LLC.
- B. Description: Solid state, with SPST dry contacts rated for 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.

3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
6. Failure Mode: Luminaire stays ON.

## 2.3 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Leviton Manufacturing Co., Inc.
4. Lutron Electronics Co., Inc.
5. Philips Lighting Controls.
6. Sensor Switch, Inc.

- B. General Requirements for Sensors:

1. Wall or ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Passive infrared, ultrasonic or dual technology, as identified on Drawings.
3. Separate power pack.
4. Hardwired connection to switch.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:
  - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
  - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
  - c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
7. Sensor Output: Sensor is powered from the power pack.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. Mounting:

- a. Sensor: Suitable for mounting in any position on a standard outlet box.
  - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
  - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  12. Bypass Switch: Override the "on" function in case of sensor failure.
  13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.
- C. PIR Type: Wall or ceiling mounted, as indicated on Drawings; detect occupants in coverage area by their heat and movement.
1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
  2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.
  4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet (110 square meters) when mounted 120 inches (3050 mm) above finished floor.
- D. Ultrasonic Type: Wall or ceiling mounted, as indicated on Drawings; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
  2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).
  6. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet (110 square meters) when mounted 120 inches (3050 mm) above finished floor.
- E. Dual-Technology Type: Wall or ceiling mounted, as indicated on Drawings; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or

combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet (110 square meters) when mounted 120 inches (3050 mm) above finished floor.

#### 2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Leviton Manufacturing Co., Inc.
4. Lutron Electronics Co., Inc.
5. Philips Lighting Controls.
6. Sensor Switch, Inc.

- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, using hardwired connection.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with NECA 1.

- B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- E. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 0553 "Identification for Electrical Systems."
- B. Label time switches.

### 3.4 FIELD QUALITY CONTROL

- A. Refer to commissioning requirements as identified in the Automatic Lighting Control Performance Specification on the Drawings.
- B. Perform the following tests and inspections:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lighting control devices will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

### 3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

### 3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 0923

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## SECTION 26 2416 PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### 1.2 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Include evidence of NRTL listing for series rating of installed devices.
  - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.5 FIELD CONDITIONS

- A. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet (2000 m).



1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: For flush or surface mounting as per Drawings, dead front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Height: 90 inches (2286 mm) maximum.
  - 3. Front: Secured to box with screws. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
  - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- E. Incoming Mains Location: Top or bottom, as per Drawings and as verified by Contractor.
- F. Phase, Neutral, and Ground Buses: Tin-plated aluminum.
- G. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Tin-plated aluminum.
  - 2. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
  - 3. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
- H. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent

protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

- I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- J. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.

## 2.2 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Eaton.
  - 2. General Electric Company; GE Energy Management - Electrical Distribution.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Mains: Circuit breaker or lugs only, as per Drawings.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers. Bolt-on circuit breakers or plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

## 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. General Electric Company; GE Energy Management - Electrical Distribution.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

- C. Mains: Circuit breaker or lugs only, as per Drawings.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

#### 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Provide standard products of the same manufacturer as the panelboard.
- B. MCCB: Comply with UL 489, with series-connected rating and/or interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  - 3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
  - 4. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  - 5. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.
    - c. UL listed for reverse connection without restrictive line or load ratings.
    - d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
    - e. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    - g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

#### 2.5 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NEMA PB 1.1.
- C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box.
- E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- H. Install filler plates in unused spaces.
- I. At recessed panelboards, stub four 1-inch (27-EMT) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

#### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 0553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 26 0553 "Identification for Electrical Systems" identifying source of remote circuit.

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 2416

## SECTION 26 2726 WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Standard-grade receptacles.
  - 2. USB receptacles.
  - 3. GFCI receptacles.
  - 4. Toggle switches, 120/277 V.
  - 5. Wall-box dimmers.
  - 6. Wall plates.

#### 1.2 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
- F. Wall Plate Color: For plastic covers, match device color.
- G. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Eaton (Arrow Hart).
  - b. Hubbell Incorporated; Wiring Device-Kellems.
  - c. Legrand/Pass & Seymour
  - d. Leviton Manufacturing Co., Inc.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.3 STANDARD-GRADE RECEPTACLES, 125 V, 15 A

A. Tamper-Resistant Duplex Receptacles, 125 V, 15 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Eaton (Arrow Hart).
  - b. Hubbell Incorporated; Wiring Device-Kellems.
  - c. Legrand/Pass & Seymour
  - d. Leviton Manufacturing Co., Inc.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-15R.
4. Standards: Comply with UL 498 and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.4 USB RECEPTACLES

A. USB Charging Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Eaton (Arrow Hart).
  - b. Hubbell Incorporated; Wiring Device-Kellems.
  - c. Legrand/Pass & Seymour
  - d. Leviton Manufacturing Co., Inc.
2. Description: Two pole, three wire, and self-grounding. Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Combination Tamper-Resistant Specification Grade Duplex Convenience Receptacles with (2) USB ports, 125 V, 20 A; overall 30W charging capability with (1) USB Type-A & (1) USB Type-C port powered by smart current sharing technology to allow for full 3A through a singular Type-C port.; slim design allows for installation in standard depth wall boxes; reinforced nylon USB Type-A ports; Stainless steel auto-ground clips assure positive ground; efficient power supply meets the US Department of Energy Level VI no-load power requirement of 100mW max for external power supplies.
5. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 Supplement SD, UL 1310, CSA C22.2 No. 42, CSA 22.2 No. 223 and Federal Specification W-C-596.GFCI RECEPTACLES, 125 V, 20 A

2.5 GFCI RECEPTACLES, 125 V, 20 A

A. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Eaton (Arrow Hart).
  - b. Hubbell Incorporated; Wiring Device-Kellems.
  - c. Legrand/Pass & Seymour
  - d. Leviton Manufacturing Co., Inc.
2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed-through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.



2.6 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Eaton (Arrow Hart).
  - b. Hubbell Incorporated; Wiring Device-Kellems.
  - c. Legrand/Pass & Seymour
  - d. Leviton Manufacturing Co., Inc.
2. Standards: Comply with UL 20 and FS W-S-896.

B. Three-Way Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Eaton (Arrow Hart).
  - b. Hubbell Incorporated; Wiring Device-Kellems.
  - c. Legrand/Pass & Seymour
  - d. Leviton Manufacturing Co., Inc.
2. Standards: Comply with UL 20 and FS W-S-896.

2.7 DIMMERS

A. Wall-Box Dimmers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Eaton (Arrow Hart).
  - b. Hubbell Incorporated; Wiring Device-Kellems.
  - c. Legrand/Pass & Seymour
  - d. Leviton Manufacturing Co., Inc.
2. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
3. Control: Continuously adjustable slider; with single-pole or three-way switching.
4. Standards: Comply with UL 1472.

5. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

## 2.8 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
  3. Material for Unfinished Spaces: Galvanized steel.
  4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with while-in-use with lockable cover.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  1. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  2. Install wiring devices after all wall preparation, including painting, is complete.
- C. Device Installation:
  1. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
  2. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- D. Receptacle Orientation:
  1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

- E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
  
- F. Dimmers:
  - 1. Install dimmers within terms of their listing.
  - 2. Verify that dimmers used for fan-speed control are listed for that application.
  - 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.
  
- G. Wet-Location, Weatherproof devices mounted on stud wall shall be mounted on flush/recessed box. Surface boxes shall only be allowed where installed on concrete wall/foundation, where mounted on equipment or when located in an area specifically identified for surface wiring methods.
  
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

END OF SECTION 26 2726

## SECTION 26 2816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Non-fusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
2. Enclosure types and details for types other than UL 50E, Type 1.
3. Current and voltage ratings.
4. Short-circuit current ratings (interrupting and withstand, as appropriate).
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 FUSIBLE SWITCHES

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

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 240 V(ac).
4. 200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in both open and closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

2.3 NON-FUSIBLE SWITCHES

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

1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Type GD, General Duty, Three Pole, Single Throw, 240 V(ac), 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

#### 2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ABB, Electrification Business.
  2. Eaton.
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; Schneider Electric USA.
- B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.
- C. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker. Circuit breakers must be 100 percent rated for available fault current.
- E. MCCBs must be equipped with device for locking in isolated position.
- F. Lugs must be suitable for 90 deg C rated wire, sized in accordance with 75 deg C temperature rating in NFPA 70.
- G. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

#### 2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.

- B. Enclosure Finish: Enclosure must be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1); or gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (UL 50E Types 3R, 12).
- C. Conduit Entry: UL 50E Types 3R and 12 enclosures may not contain knockouts.
- D. Operating Mechanism: Circuit-breaker operating handle must be directly operable through front cover of enclosure (UL 50E Type 1); directly operable through dead front trim of enclosure (UL 50E Type 3R). Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure to override interlock.

### PART 3 - EXECUTION

#### 3.1 SELECTION OF ENCLOSURES

- A. Indoor, Dry and Clean Locations: UL 50E, Type 1.
- B. Outdoor Locations: UL 50E, Type 3R.

#### 3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
  - 1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
  - 2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
  - 3. Install fuses in fusible devices.

#### 3.3 IDENTIFICATION

- A. Comply with requirements in Section 26 0553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure.

3.4 FIELD QUALITY CONTROL

A. [Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

- a. Inspect physical and mechanical condition.
- b. Inspect anchorage, alignment, grounding, and clearances.
- c. Verify that unit is clean.
- d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
- e. Verify that fuse sizes and types match the Specifications and Drawings.
- f. Verify that each fuse has adequate mechanical support and contact integrity.
- g. Inspect bolted electrical connections for high resistance using one of the following methods:
  - 1) Use low-resistance ohmmeter.
    - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
- h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on Drawings.
- i. Verify correct phase barrier installation.
- j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

B. Tests and Inspections for Molded-Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that unit is clean.
- e. Operate circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the following methods:



- 1) Use low-resistance ohmmeter.
    - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.

C. Nonconforming Work:

1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION 26 2816

## SECTION 26 2913 ENCLOSED CONTROLLERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed controller.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

### PART 2 - PRODUCTS

#### 2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Eaton.
    - b. General Electric Company.

- c. Rockwell Automation, Inc.
- d. Siemens Industry, Inc.
- e. Square D.

- 2. Configuration: Non-reversing.
- 3. Surface mounting.

## 2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
  - 1. Dry and Clean Indoor Locations: Type 1.
  - 2. Outdoor Locations: Type 3R.
  - 3. Other Wet or Damp Indoor Locations: Type 4.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height, and with disconnect operating handles not higher than 79 inches (2006 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 26 0529 "Hangers and Supports for Electrical Systems."
- B. Comply with NECA 1.

### 3.2 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved nameplate.

END OF SECTION 26 2913

## SECTION 26 3213 DIESEL-ENGINE-DRIVEN GENERATOR SETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes packaged engine generators used to supply non-emergency power, with the following features:
  - 1. Diesel engine.
  - 2. Diesel fuel-oil system.
  - 3. Control and monitoring.
  - 4. Generator overcurrent and fault protection.
  - 5. Generator, exciter, and voltage regulator.
  - 6. Vibration isolation devices.
  - 7. Weather proof sound enclosures.
  - 8. Base fuel tank.
  
- B. Related Requirements:
  - 1. Section 26 3600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  
- B. Shop Drawings:
  - 1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Identify fluid drain ports and clearance requirements for proper fluid drain.
  - 4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
  - 5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
  - 6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for engine generators and functional relationship between all electrical components.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Caterpillar, Inc.; Electric Power Division.
  - 2. Cummins Power Generation.
  - 3. Generac.
  - 4. Kohler Power Systems.

2.2 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance:
  - 1. Comply with NFPA 37.
  - 2. Comply with NFPA 70.
  - 3. Comply with NFPA 110 requirements for Level 2 EPSS.
- B. UL Compliance: Comply with UL 2200.
- C. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  - 1. Ambient Temperature: minus 40 to 140 deg F (minus 40 to plus 60 deg C).
  - 2. Relative Humidity: Zero to 95 percent.
  - 3. Altitude: Sea level to 1000 feet (300 m).

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Power Rating: Standby.
- D. EPSS Class: Engine generator shall be classified as a Class 24 according to NFPA 110.
- E. Service Load: 100KW/125KVA.
- F. Power Factor: 1.0.
- G. Frequency: 60 Hz.
- H. Voltage: 208-V ac.
- I. Phase: Three-phase, four wire, wye.
- J. Induction Method: Naturally aspirated or Turbocharged.
- K. Governor: Adjustable isochronous, with speed sensing.
- L. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
- M. Capacities and Characteristics:
  - 1. Power Output Ratings: Nominal ratings as indicated at 1.0 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
  - 2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- N. Engine Generator Performance:
  - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
  - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
  - 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time:
  - a. Comply with NFPA 110, Type 10 system requirements.

#### 2.4 DIESEL ENGINE

- A. Fuel: ASTM D975, diesel fuel oil, Grade 2-D S15.
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: Engine or skid-mounted.
  1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
  2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
  3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499.
- E. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.
  1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
  3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.
  - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
  - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
  
- F. Muffler/Silencer: Semi-critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
  1. Minimum sound attenuation of 18 dB at 500 Hz.
  2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 85 dBA or less.
  
- G. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
  
- H. Starting System: 12-V electric, with negative ground.
  1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
  2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
  3. Cranking Cycle: As required by NFPA 110 for system level specified.
  4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least twice without recharging.
  5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
  6. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
  7. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
    - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 to 140 deg F (minus 40 to plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.



- c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
- d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

## 2.5 DIESEL FUEL-OIL SYSTEM

- A. Comply with NFPA 37.
- B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 231113 "Facility Fuel-Oil Piping." Cast iron, aluminum, copper, and galvanized steel shall not be used in the fuel-oil system.
- C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.
- D. Fuel Filtering: Remove water and contaminants larger than 1 micron.
- E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:
  - 1. Tank level indicator.
  - 2. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for 24 hours continuous operation plus fuel for periodic maintenance operations between fuel refills.
  - 3. Leak detection in interstitial space.
  - 4. Vandal-resistant fill cap.
  - 5. Containment Provisions: Comply with requirements of authorities having jurisdiction.

## 2.6 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.
- B. Provide minimum run time control set for 15 minutes with override only by operation of a remote emergency-stop switch.
- C. Comply with UL 508A.

- D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.
- E. Control and Monitoring Panel:
1. Digital engine generator controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
  2. Instruments: Located on the control and monitoring panel and viewable during operation.
    - a. Engine lubricating-oil pressure gage.
    - b. Engine-coolant temperature gage.
    - c. DC voltmeter (alternator battery charging).
    - d. Running-time meter.
  3. Controls and Protective Devices: Controls, shutdown devices, and common alarm indication, including the following:
    - a. Cranking control equipment.
    - b. Run-Off-Auto switch.
    - c. Control switch not in automatic position alarm.
    - d. Overcrank alarm.
    - e. Overcrank shutdown device.
    - f. Low-water temperature alarm.
    - g. High engine temperature.
    - h. High engine temperature shutdown device.
    - i. Overspeed alarm.
    - j. Overspeed shutdown device.
    - k. Low fuel main tank.
      - 1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for duration required in "Fuel Tank Capacity" Subparagraph in "Diesel Fuel-Oil System" Article.
    - l. Coolant low-level alarm.
    - m. EPS load indicator.
    - n. Battery high-voltage alarm.
    - o. Low cranking voltage alarm.
    - p. Battery-charger malfunction alarm.
    - q. Battery low-voltage alarm.
    - r. Lamp test.
    - s. Contacts for local and remote common alarm.
    - t. Remote manual stop shutdown device.
    - u. Air shutdown damper alarm when used.

- v. Air shutdown damper shutdown device when used.
  - w. Hours of operation.
  - x. Engine generator metering, including voltage, current, hertz, kilowatt, kilovolt ampere, and power factor.
- F. Common Remote Panel with Common Audible Alarm: Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered from the engine generator battery.
- G. Remote Alarm Annunciator: An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- 1. Overcrank alarm.
  - 2. Low water-temperature alarm.
  - 3. High engine temperature prealarm.
  - 4. High engine temperature alarm.
  - 5. Low lube oil pressure alarm.
  - 6. Overspeed alarm.
  - 7. Low fuel main tank alarm.
  - 8. Low coolant level alarm.
  - 9. Low cranking voltage alarm.
  - 10. Contacts for local and remote common alarm.
  - 11. Audible-alarm silencing switch.
  - 12. Air shutdown damper when used.
  - 13. Run-Off-Auto switch.
  - 14. Control switch not in automatic position alarm.
  - 15. Fuel tank derangement alarm.
  - 16. Fuel tank high-level shutdown of fuel supply alarm.
  - 17. Lamp test.
- H. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.
- I. Remote Emergency-Stop Switch: Flush; wall mounted unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.
- 2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION
- A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.

1. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
  2. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.
- B. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
  2. Trip Rating: Matched to generator output rating.
  3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
  4. Mounting: Adjacent to, or integrated with, control and monitoring panel.

## 2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide six-lead alternator.
- E. Range: Provide limited range of output voltage by adjusting the excitation level.
- F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- G. Enclosure: Dripproof.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
  2. Maintain voltage within 15 percent on one step, full load.
  3. Provide anti-hunt provision to stabilize voltage.
  4. Maintain frequency within 10 percent and stabilize at rated frequency within 5 seconds.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 12 percent, maximum.

## 2.9 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene separated by steel shims.
2. Minimum Deflection: 1 inch (25 mm).

B. Comply with requirements in Section 232116 "Hydronic Piping Specialties" for vibration isolation and flexible connector materials for steel piping.

C. Comply with requirements in Section 233113 "Metal Ducts" for vibration isolation and flexible connector materials for exhaust shroud and ductwork.

D. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

## 2.10 GENERATOR ENCLOSURE

A. Provide a Level 2, sound attenuated, weatherproof enclosure. Manufacturers standard steel enclosure and painted finish. Approximately 70 dbA @ 25'.

## 2.11 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components, and equipped with identical or equivalent accessories.

1. Tests: Comply with IEEE 115.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Comply with NECA 1 and NECA 404.

B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.

C. Equipment Mounting:

1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03 3000 "Cast-in-Place Concrete."
2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
3. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases.

D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

E. Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.2 CONNECTIONS

A. Ground equipment according to Section 26 0526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.

C. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.3 IDENTIFICATION

A. Identify system components according to Section 26 0553 "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.
  - a. Visual and Mechanical Inspection:
    - 1) Compare equipment nameplate data with Drawings and the Specifications.
    - 2) Inspect physical and mechanical condition.
    - 3) Inspect anchorage, alignment, and grounding.
    - 4) Verify that the unit is clean.
  - b. Electrical and Mechanical Tests:
    - 1) Perform insulation-resistance tests according to IEEE 43.
      - a) Machines 200 hp (150 kW) or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.
    - 2) Test protective relay devices.
    - 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
    - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
    - 5) Verify correct functioning of the governor and regulator.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
  - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
  - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
  - c. Verify acceptance of charge for each element of the battery after discharge.
  - d. Verify that measurements are within manufacturer's specifications.
4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
7. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 and 100 percent of rated linear load. Verify that harmonic content is within specified limits.

- C. Coordinate tests with tests for transfer switches and run them concurrently.
- D. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 26 3213



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## **SECTION 26 3600 TRANSFER SWITCHES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes automatic transfer switches rated 600 V and less.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
  - 2. Single-Line Diagram: Show connections between transfer switch, power sources, and load.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

#### **1.4 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 110.
- D. Comply with UL 1008 unless requirements of these Specifications are stricter.

- E. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- F. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
  - 1. Short-time withstand capability for three cycles.
- G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- J. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- K. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed or tape markers at terminations. Color-coding and wire and cable markers are specified in Section 26 0553 "Identification for Electrical Systems."
  - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
  - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
  - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
  - 4. Accessible via front access.
- L. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

## 2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Schieder Electric/ASCO.
  - 2. ABB, Electrification Business.
  - 3. Caterpillar, Inc.; Electric Power Division.

4. Cummins Power Generation.
  5. Eaton.
  6. Generac.
  7. Kohler Power Systems.
  8. Russelectric, Inc.
- B. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
  2. Switch Action: Double throw; mechanically held in both directions.
  3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
  4. Conductor Connectors: Suitable for use with conductor material and sizes.
  5. Material: Tin-plated aluminum.
  6. Main and Neutral Lugs: Mechanical type.
  7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  8. Ground bar.
  9. Connectors shall be marked for conductor size and type according to UL 1008.
- C. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- D. Automatic Transfer-Switch Controller Features:
1. Controller operates through a period of loss of control power.
  2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
  3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
  4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
  5. Test Switch: Simulate normal-source failure.
  6. Switch-Position Pilot Lights: Indicate source to which load is connected.
  7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

- a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
  - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
  9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
  10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
  11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
  12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    - b. Push-button programming control with digital display of settings.
    - c. Integral battery operation of time switch when normal control power is unavailable.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- B. Identify components according to Section 26 0553 "Identification for Electrical Systems."
- C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- D. Comply with NECA 1.

#### 3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as

recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
  - 1. Comply with requirements for raceways and boxes specified in Section 26 0533 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 26 0526 "Grounding and Bonding for Electrical Systems."
- E. Connect twisted pair cable according to Section 26 0523 "Control-Voltage Electrical Power Cables."
- F. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.
- G. Brace and support equipment according to Section 260548.16 "Seismic Controls for Electrical Systems."
- H. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches (457 mm) in length.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with Drawings and Specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, grounding, and required clearances.
    - d. Verify that the unit is clean.
    - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
    - f. Verify that manual transfer warnings are attached and visible.
    - g. Verify tightness of all control connections.
    - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
      - 1) Use of low-resistance ohmmeter.

- 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
  - i. Perform manual transfer operation.
  - j. Verify positive mechanical interlocking between normal and alternate sources.
  - k. Perform visual and mechanical inspection of surge arresters.
  - l. Inspect control power transformers.
    - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
    - 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
    - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
2. Electrical Tests:
  - a. Perform insulation-resistance tests on all control wiring with respect to ground.
  - b. Verify settings and operation of control devices.
  - c. Calibrate and set all relays and timers.
  - d. Verify phase rotation, phasing, and synchronized operation.
  - e. Perform automatic transfer tests.
  - f. Verify correct operation and timing of the following functions:
    - 1) Normal source voltage-sensing and frequency-sensing relays.
    - 2) Engine start sequence.
    - 3) Time delay on transfer.
    - 4) Alternative source voltage-sensing and frequency-sensing relays.
    - 5) Automatic transfer operation.
    - 6) Interlocks and limit switch function.
    - 7) Time delay and retransfer on normal power restoration.
    - 8) Engine cool-down and shutdown feature.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
  - a. Check for electrical continuity of circuits and for short circuits.
  - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
  - c. Verify that manual transfer warnings are properly placed.
  - d. Perform manual transfer operation.
4. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.

- a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
  - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
  - c. Verify time-delay settings.
  - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
  - e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- B. Coordinate tests with tests of generator and run them concurrently.
- C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- D. Transfer switches will be considered defective if they do not pass tests and inspections.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Prepare test and inspection reports.

#### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

END OF SECTION 26 3600



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## SECTION 27 1100 COMMUNICATIONS EQUIPMENT ROOM FITTINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Grounding.

B. Related Requirements:

1. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

#### 1.2 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."

#### 2.2 EQUIPMENT FRAMES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ADC.
2. AMP; a Tyco Electronics Corporation brand; a TE Connectivity Ltd. company.
3. Belden Inc.
4. B-line, an Eaton business.
5. Emerson Network Power Connectivity Solutions.
6. Hubbell Premise Wiring.
7. Leviton Manufacturing Co., Inc.

8. Ortronics, Inc.
9. Panduit Corp.
10. Siemon Co. (The).
11. <Insert manufacturer's name>.

B. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch (480-mm) panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

C. Wall-Mounted Racks: Modular-type, aluminum construction.

1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
2. Baked-polyester powder coat finish.
3. Provide swing open type, minimum 35u.

D. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

## 2.3 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.
3. Six, 15-A, 120-V ac, NEMA WD 6, Configuration 5-15R receptacles.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
8. Cord connected with 15-foot (4.5-m) line cord.
9. Rocker-type on-off switch, illuminated when in on position.
10. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.4 GROUNDING

- A. Comply with requirements in Section 27 0526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
  - 1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
  - 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
  - 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with J-STD-607-A.

2.5 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
  - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
  - 2. Record agreements reached in meetings and distribute them to other participants.

3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
  4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

### 3.3 FIRESTOPPING

- A. Comply with requirements in Section 07 8413 "Penetration Firestopping."

### 3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

END OF SECTION 27 1100

## SECTION 27 1500 COMMUNICATIONS HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Cable connecting hardware, patch panels, and cross-connects.
3. Telecommunications outlet/connectors.
4. Cabling system identification products.

#### 1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate telecommunications outlet/connector locations with location of power receptacles at each location.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

### PART 2 - PRODUCTS

#### 2.1 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.

1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
2. Bridged taps and splices shall not be installed in the horizontal cabling.

## 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  1. Flame-Spread Index: 25 or less.
  2. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Grounding: Comply with J-STD-607-A.

## 2.3 CATEGORY 6 TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- C. Conductors: 100-ohm, 23 AWG solid copper.
- D. Shielding/Screening: Unshielded twisted pairs (UTP).
- E. Jacket: Thermoplastic, colors as indicated on riser diagram.

## 2.4 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. General Requirements for Twisted Pair Cable Hardware:
  1. Comply with the performance requirements of Category 6.
  2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
  3. Cables shall be terminated with connecting hardware of same category or higher.

- C. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.
- D. Connecting Blocks:
  - 1. 110-style IDC for Category 6.
  - 2. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
  - 1. Features:
    - a. Universal T568A and T568B wiring labels.
    - b. Labeling areas adjacent to conductors.
    - c. Replaceable connectors.
    - d. 24 or 48 ports.
  - 2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
  - 3. Number of Jacks per Field: One for each four-pair cable.
- F. Patch Cords: Factory-made, four-pair cables in 48-inch (1200-mm) lengths; terminated with an eight-position modular plug at each end.
  - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
  - 2. Patch cords shall have color-coded boots for circuit identification.
- G. Plugs and Plug Assemblies:
  - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
  - 2. Standard: Comply with TIA-568-C.2.
  - 3. Marked to indicate transmission performance.
- H. Jacks and Jack Assemblies:
  - 1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
  - 2. Designed to snap-in to a patch panel or faceplate.
  - 3. Standard: Comply with TIA-568-C.2.
  - 4. Marked to indicate transmission performance.
- I. Faceplate:
  - 1. Two port, vertical single gang faceplates designed to mount to single gang wall boxes.



2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
3. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.

J. Legend:

1. Machine printed, in the field, using adhesive-tape label.

2.5 GROUNDING

- A. Comply with requirements in Section 27 0526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with J-STD-607-A.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 26 0553 "Identification for Electrical Systems."

2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP cables according to TIA/EIA-568-B.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
  - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
  - 2. Install lacing bars and distribution spools.
  - 3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
  - 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### 3.4 FIRESTOPPING

- A. Comply with requirements in Section 07 8413 "Penetration Firestopping."

### 3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
- B. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- C. Cable and Wire Identification:
  1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  2. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.

3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

- D. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

### 3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Visually inspect UTP jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm Category 5e, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
  - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
5. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
  - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
  - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

- B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 27 1500

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## SECTION 27 1533 COMMUNICATIONS COAXIAL HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. CATV coaxial cable.
  2. Coaxial cable hardware.
  3. Identification products.

#### 1.2 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 GENERAL CABLE CHARACTERISTICS

- A. Communications Cable: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
1. Communications, Plenum Rated: Type CMP complying with UL 1685.
  2. Communications, Plenum Rated: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
- B. CATV Cable: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
1. CATV Cable: Type CATV in fireproof riser shafts with firestops at each penetration.

#### 2.2 CATV COAXIAL CABLE

- A. Description: Coaxial cable with a 75-ohm characteristic impedance designed for CATV transmission.
- B. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70, "Community Antenna Television and Radio Distribution Systems" Article. Types are as follows:
1. RG-6/U: UL Type CATVP.
    - a. No. 18 AWG, solid, copper-covered steel conductor.
    - b. Plenum rated.



- c. Gas-injected, foam-PE insulation.
- d. Shielded with 100 percent aluminum tape and 40 percent aluminum braid.
- e. Double shielded with 100 percent aluminum foil shield, 60 percent aluminum braided inner shield, and 40 percent aluminum braided outer shield.
- f. Jacketed with black PVC or PE.
- g. Suitable for indoor installations.

### 2.3 COAXIAL CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate coaxial cable with a 75-ohm characteristic impedance.
- B. Coaxial-Cable Connectors: Type BNC, 75 ohms.
- C. Jacks and Jack Assemblies: Modular, color-coded, with female Type BNC connectors.
- D. Patch Cords: Factory-made cables in 48-inch (1200-mm) lengths; terminated with a male Type BNC connector at each end.
- E. Faceplates:
  - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
  - 2. For use with snap-in jacks accommodating any combination of twisted pair, optical-fiber, and coaxial work area cords.
    - a. Flush-mounted jacks, positioning the cord at a 90-degree angle from faceplate surface.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Coordinate horizontal cabling with the protectors and demarcation point provided by communications service provider.

### 3.2 INSTALLATION OF COAXIAL HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. General Requirements for Cabling:

1. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
2. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and patch panels.
3. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
4. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
9. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems," "Pulling Cable" Section. Monitor cable pull tensions.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend coaxial cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
2. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
3. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 FIRESTOPPING

- A. Comply with requirements in Section 07 8413 "Penetration Firestopping."

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
- B. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- C. Cable and Wire Identification:
  - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  - 3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communications cabling, use a different color for jacks and plugs of each service.
- D. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:
  - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections.
- B. Tests and Inspections:
  - 1. Visually inspect coaxial jacket materials for NRTL certification markings.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test coaxial horizontal copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 27 1533

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## SECTION 28 3111 DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Sounder base smoke detectors.
5. Notification appliances.
6. Remote annunciator.
7. Addressable interface device.
8. Digital alarm communicator transmitter.
9. Cellular alarm communicator transmitter.
10. Fire alarm cable and wire.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product, including furnished options and accessories.

##### B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
  - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
  - b. Show field wiring required for HVAC unit shutdown on alarm.
  - c. Locate detectors according to manufacturer's written recommendations.

12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
  - a. Trained and certified by manufacturer in fire-alarm system design.
  - b. NICET-certified, fire-alarm technician.
  - c. Licensed or certified by authorities having jurisdiction.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:
  - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
  - c. Complete wiring diagrams showing connections between all devices and equipment.
  - d. Riser diagram.
  - e. Record copy of site-specific software.
  - f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
    - 1) Equipment tested.
    - 2) Frequency of testing of installed components.
    - 3) Frequency of inspection of installed components.
    - 4) Requirements and recommendations related to results of maintenance.
    - 5) Manufacturer's user training manuals.
  - g. Manufacturer's required maintenance related to system warranty requirements.
  - h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm technician.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
  - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Source Limitations for Fire-Alarm System and Components: Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.
- C. Fire-alarm control unit shall utilize non-proprietary software. System shall be able to be programmed by trained technicians but not have to be manufacturer's personnel. Programming shall be able to be accomplished by electricians or technicians not associated with the manufacturer.
- D. Automatic sensitivity control of certain smoke detectors.
- E. All components provided shall be listed for use with the selected system.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
  - 1. Manual stations.
  - 2. Smoke detectors.
  - 3. Duct smoke detectors.
  - 4. Automatic sprinkler system water flow.
- B. Fire-alarm signal shall initiate the following actions:



1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station via radio master box.
4. Unlock electric door locks in designated egress paths.
5. Recall elevators to primary or alternate recall floors.
6. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Carbon monoxide detectors.
2. Sounder base, unit smoke detectors and carbon monoxide sensors.
3. Valve supervisory switch.
4. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, or remote annunciator.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

## 2.3 FIRE-ALARM CONTROL UNIT

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Bosch Security Systems, Inc.
2. Edwards; Carrier Global Corporation.
3. Fike Corporation.
4. Fire-Lite Alarms; Honeywell International, Inc.
5. Gamewell-FCI; Honeywell International, Inc.
6. Mircom Technologies, Ltd.
7. Notifier; Honeywell International, Inc.
8. Siemens Industry, Inc., Building Technologies Division.
9. Silent Knight; Honeywell International, Inc.

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
  2. Fire-alarm control unit shall utilize non-proprietary software. System shall be able to be programmed by trained technicians but not have to be manufacturer's personnel. Programming shall be able to be accomplished by electricians or technicians not associated with the manufacturer.
  3. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
  4. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 40 characters, minimum.
  2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
1. Pathway Class Designations: NFPA 72, Class B.
  2. Pathway Survivability: Level 0.
- E. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
  2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
  3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- F. Elevator Recall:
1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
    - a. Elevator lobby detectors except the lobby detector on the designated floor.
    - b. Smoke detector in elevator machine room.
  2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
- G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.
- H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

- I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
  - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

## 2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.
  - 1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
  - 2. Station Reset: Key- or wrench-operated switch.

## 2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
  - 1. Comply with UL 268; operating at 24-V dc, nominal.
  - 2. Detectors shall be four-wire type.
  - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
  - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
  - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  - 6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
  - 7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition.
    - a. Multiple levels of detection sensitivity for each sensor.
    - b. Sensitivity levels based on time of day.
- B. Photoelectric Smoke Detectors:
  - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - a. Primary status.
    - b. Device type.
    - c. Present average value.
    - d. Present sensitivity selected.
    - e. Sensor range (normal, dirty, etc.).

C. Sounder Bases for Smoke Detectors:

1. Smoke detector sounder base shall produce distinctive temporal pattern fire alarm signal (ANSI Temporal 3).
2. Sounder base for smoke detectors shall have a Form C output relay.

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire-alarm system.

1. Mounting: Adapter plate for outlet box mounting.
2. Testable by introducing test carbon monoxide into the sensing cell.
3. Detector shall provide alarm contacts and trouble contacts.
4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
5. Comply with UL 2075.
6. Locate, mount, and wire according to manufacturer's written instructions.
7. Provide means for addressable connection to fire-alarm system.
8. Test button simulates an alarm condition.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464.
- C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
  - 1. Mounting: Wall mounted unless otherwise indicated.
  - 2. Flashing shall be in a temporal pattern, synchronized with other units.
  - 3. Strobe Leads: Factory connected to screw terminals.
  - 4. Mounting Faceplate: Factory finished, white.

## 2.8 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
  - 1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

## 2.9 ADDRESSABLE INTERFACE DEVICE

- A. General:
  - 1. Include address-setting means on the module.
  - 2. Store an internal identifying code for control panel use to identify the module type.
  - 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.
  - 1. Allow the control panel to switch the relay contacts on command.
  - 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:
  - 1. Operate notification devices.
  - 2. Operate solenoids for use in sprinkler service.

## 2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
  
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
  - 1. Verification that both telephone lines are available.
  - 2. Programming device.
  - 3. LED display.
  - 4. Manual test report function and manual transmission clear indication.
  - 5. Communications failure with the central station or fire-alarm control unit.
  
- D. Digital data transmission shall include the following:
  - 1. Address of the alarm-initiating device.
  - 2. Address of the supervisory signal.
  - 3. Address of the trouble-initiating device.
  - 4. Loss of ac supply.
  - 5. Loss of power.
  - 6. Low battery.
  - 7. Abnormal test signal.
  - 8. Communication bus failure.
  
- E. Secondary Power: Integral rechargeable battery and automatic charger.
  
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

## 2.11 CELLULAR ALARM COMMUNICATOR TRANSMITTER

- A. Cellular alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL S3511.
  
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically send signal via cellular connection to a central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
  
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
  - 1. Verification that both telephone lines are available.
  - 2. Programming device.
  - 3. LED display.
  - 4. Manual test report function and manual transmission clear indication.

5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

## 2.12 FIRE ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer and identified in the approved submittal package.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multi-conductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NRTL listed for fire alarm and cable tray installation, plenum rated.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.

3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing: Comply with NFPA 72.

E. Sounder based smoke detectors shall be provided within the dwelling units as indicated on plans. Upon sensing smoke and going into alarm, the smoke detector shall provide audible alarm through its sounder base and shall send signal through the addressable loop, causing all the smoke detectors within the unit to provide the audible alarm in a synchronized, temporal pattern. The fire alarm system shall receive the signal as a supervisory alarm, identifying which unit is in alarm. Sounder base smoke detectors shall only cause audible signaling within the unit they are located and shall not alarm all signaling devices throughout the building.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.

G. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

I. Device Location-Indicating Lights: Locate in public space near the device they monitor.

J. Master Radio Call Box: Coordinate location of the Master Radio Call Box as well as all programming with the Burlington Fire Department as outlined in the document "Master Radio Call Box Information and Programming Protocols".

### 3.2 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

### 3.3 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.



- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Electronically locked doors and access gates.
  - 2. Alarm-initiating connection to elevator recall system and components.
  - 3. Supervisory connections at valve supervisory switches.
  - 4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

### 3.5 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

### 3.6 FIELD QUALITY CONTROL

- A. Field tests may be witnessed by authorities having jurisdiction.
- B. Perform the following tests and inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter.
    - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
  - 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
  - 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
  - 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72

and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

### 3.7 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

### 3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 3111

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## 310513 SOILS FOR EARTHWORK

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Subsoil materials.
- B. Topsoil materials.

#### 1.2 RELATED SECTIONS

- A. Section 312213 Rough Grading.
- B. Section 312333 Trenching and Backfilling.

#### 1.3 REFERENCES

- A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.
- B. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- C. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- D. ASTM D2487 - Classification of Soils for Engineering Purposes.
- E. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

#### 1.4 SUBMITTALS FOR REVIEW

- A. Samples: Submit sieve analyses and proctors for each type of fill. Soil testing to be provided by testing laboratory accepted by engineer.

#### 1.5 SUBMITTALS FOR INFORMATION

- A. DIVISION 1- Submittals: Procedures for submittals.
- B. Materials Source: Submit name of imported materials source.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).

## PART 2 - PRODUCTS

### 2.1 SUBSOIL MATERIALS

- A. As defined in Geotechnical report, otherwise:
  - 1. Subsoil Type S1: Native Material with 14 percent passing the no. 200 sieve.
  - 2. Subsoil Type S2:
    - a. Excavated and re-used material.
    - b. 30 percent passing the no. 200 sieve.
    - c. Free of lumps larger than 3 inches, and containing no organic materials.

### 2.2 TOPSOIL MATERIALS

- A. Topsoil
  - 1. Excavated and reused material.
  - 2. Graded.
  - 3. Free of roots, rocks larger than 1/2inch, subsoil, debris, large weeds and foreign matter.
  - 4. Conforming to ASTM D2487 Group Symbol OH.

### 2.3 SOURCE QUALITY CONTROL

- A. DIVISION 1 - Quality Control: Testing and analysis of soil material.
- B. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D698.
- C. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D698.
- D. If tests indicate materials do not meet specified requirements, change material and retest.
- E. Provide materials of each type from same source throughout the Work.

## PART 3 - EXECUTION

### 3.1 SOIL REMOVAL

- A. Excavate subsoil and topsoil from areas designated
- B. Remove lumped soil, boulders, and rock.
- C. Stockpile excavated material in area designated on site and remove excess material not being used, from site.

### 3.2 STOCKPILING

- A. Stockpile materials offsite.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

### 3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.
- B. If a borrow area is indicated, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

## **310516 AGGREGATES FOR EARTHWORK**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Aggregate materials.

#### **1.2 RELATED SECTIONS**

- A. Section 31 05 13 - Soils for Earthwork.
- B. Section 31 20 00 - Earth Moving.
- C. Section 33 10 00 - Water Utilities.
- D. Section 33 30 00 - Sanitary Sewerage Utilities.
- E. Section 33 40 00 - Storm Drainage Utilities.

#### **1.3 REFERENCES**

- A. New Hampshire Department of Transportation – Standard Specifications for Road and Bridge Construction, latest version.
- B. AASHTO - M147 - Materials for Aggregate and Soil-Aggregate.
- C. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.
- D. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- E. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- F. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- G. ASTM D2487 - Classification of Soils for Engineering Purposes.
- H. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- I. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- J. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

#### **1.4 SUBMITTALS FOR REVIEW**

- A. Samples: Earthwork subcontractor shall notify Construction Manager of source and intended use of all imported earth materials. Construction Manager will coordinate a visit by the Testing Agent to the supplier so samples can be taken.
- B. Report: Submit sieve analysis and intended use of imported materials to engineer.

#### **1.5 SUBMITTALS FOR INFORMATION**

- A. Materials Source: Submit name of imported materials suppliers.
- B. Material Gradation: Submit gradation report for each type of imported material.
- C. Material Use: Submit use location for each type of imported material.

1.6 QUALITY ASSURANCE

- A. Earthwork subcontractor providing fill materials shall provide an ongoing testing program to assure products delivered to the site meet specifications. Gradation report and use location for each type of imported material shall be submitted to Owner and engineer.
- B. Perform Work in accordance with State of New Hampshire Department of Transportation “Standard Specifications for Road and Bridge Construction,” latest version (designated NHDOT).

PART 2 - PRODUCTS

2.1 AGGREGATE MATERIALS

A. Sand (NHDOT Item 304.1):

Sieve Designation	Percent Passing by Weight
6 Inch	100
No. 4	70 - 100
No. 200*	0 - 12
* Fraction Passing The #4 Sieve	

B. Gravel (NHDOT Item 304.2):

Sieve Designation	Percent Passing by Weight
6 Inch	100
No. 4	25 - 70
No. 200*	0 - 12
* Fraction Passing The #4 Sieve	

C. Crushed Gravel (NHDOT Item 304.3):

Sieve Designation	Percent Passing by Weight
3 Inch	100
2 Inch	95 - 100
1 Inch	55 - 85
No. 4	27 - 52
No. 200*	0 - 12
* Fraction Passing The #4 Sieve	

D. Crushed Aggregate for Shoulders (NHDOT Item 304.33):

Sieve Designation	Percent Passing by Weight
1 1/2 Inch	100
1 Inch	90 - 100
No. 4	30 - 65



No. 200 0 – 10

E. Crushed Stone (Fine) (NHDOT Item 304.4):

Sieve Designation	Percent Passing by Weight
2 Inch	100
1 1/2 Inch	85 - 100
3/4 Inch	45 - 75
No. 4	10 - 45
No. 200	0 – 5

F. Crushed Stone (Coarse) (NHDOT Item 304.5):

Sieve Designation	Percent Passing by Weight
3 1/2 Inch	100
3 Inch	85 - 100
1 1/2 Inch	60 - 90
3/4 Inch	40 - 70
No. 4	15 - 40
No. 200	0 - 5

G. Crushed Stone (Very Coarse) (NHDOT Item 304.6):

Sieve Designation	Percent Passing by Weight
6 Inch	100
3 Inch	60 - 90
1 1/2 Inch	45 - 75
3/4 Inch	35 - 65
No. 4	15 - 40
No. 200	0 - 5

H. ASTM C33-03 #67:

Sieve Designation	Percent Passing by Weight
1 Inch	100
3/4 Inch	90 - 100
3/8 Inch	20 - 55
No. 4	0 - 10
No. 200	0 - 5

I. Type I Stone Fill

Sieve Designation	Percent Passing by Weight
6 Inch	80 - 100
3 Inch	40 - 60
2 Inch	0 - 20

J. Type II Stone Fill

The longest dimension of the stone shall vary from two inches to 36 inches, and at least 50 percent of the volume of the stone in place shall have a least dimension of 12 inches.

K. Granular Borrow meeting the requirements specified in the geotechnical report. To be used where fill is required below pavement sections, below building slabs, and as foundation subgrade.

## 2.2 SOURCE QUALITY CONTROL

- A. Aggregate Material - Testing and Analysis: Perform in accordance with ASTM D698.
- B. If tests indicate materials do not meet specified requirements, change material or material source and retest.
- C. Provide materials of each type from same source throughout the Work.

## PART 3 - EXECUTION

### 3.1 STOCKPILING

- A. Stockpile materials on site at locations designated by Owner.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Direct surface water away from stockpile site so as to prevent erosion or deterioration of materials.

### 3.2 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.
- B. If a borrow area is indicated, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

## 311000 SITE CLEARING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. SECTION INCLUDES:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing site utilities.
7. Temporary erosion- and sedimentation-control measures.

##### B. RELATED SECTIONS

1. Section 312500 - Erosion & Sedimentation Control.

#### 1.2 MATERIAL OWNERSHIP

- A. Except for stripped topsoil, removed granite curbing, and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

#### 1.3 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged. Coordinate storage location with Owner.
- C. Utility Locator Service: Contractor shall call utility locator services and utility owners at least 72 hours, exclusive of weekends and holidays, in advance of digging activities:
1. Dig Safe (tel # 811)
  2. Any non Dig Safe member facility operators if know. A list of Dig Safe members by state can be found on the Dig Safe web site or here:  
[http://www.digsafe.com/member\\_companies.php](http://www.digsafe.com/member_companies.php)
  3. City of Lebanon Public Works Department (tel: 603-448-3112)
- D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.
- E. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.
  2. Parking vehicles or equipment.
  3. Foot traffic.

4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
  1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
  1. Restore damaged improvements to their original condition, as acceptable to Owner.

### 3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### 3.3 TREE AND PLANT PROTECTION

- A. General: Protect trees and plants remaining from damage.
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Owner.

### 3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
  - 1. Arrange with utility companies to shut off indicated utilities.
- B. Protection: Protect existing utility lines that are indicated to remain from damage. Notify the Engineer immediately of damage to or an encounter with an unknown existing utility line. The Contractor is responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations.
- C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Engineer not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Engineer's written permission.
- D. Removal of underground utilities is included in earthwork sections and with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections.

### 3.5 CLEARING AND GRUBBING

- A. Exercise caution and attentiveness when removing invasive species so that species will not return and in such a manner and at such a time that species seed, pollen, etc. will not spread to adjacent areas. Contact local conservation commission for assistance in identification and best removal and disposal practices.
- B. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
  - 1. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
  - 2. Use only hand methods for grubbing within protection zones.
- C. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
  - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

### 3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

**3.7 SITE IMPROVEMENTS**

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

**3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION

## 312000 EARTH MOVING

### Part 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Removal of topsoil and subsoil.
- B. Cutting, grading, filling, rough contouring, and compacting the site for site structures, roadways, parking lots, walks and equipment pads.
- C. Building perimeter and site structure backfilling to subgrade elevations.
- D. Excavating for building foundations, site structures, slabs-on-grade, paving, landscaping, and utilities.
- E. See Section 312333 for earthwork requirements immediately under and adjacent to the building foundation.
- F. Site filling and backfilling.
- G. Fill under slabs-on-grade.
- H. Fill under paving.
- I. Fill for over-excavation.
- J. Consolidation and compaction as scheduled.

#### 1.02 RELATED SECTIONS

- A. Section 310516 - Aggregates for Earthwork
- B. Section 311000 - Site Clearing
- C. Section 312500 - Erosion & Sedimentation Control
- D. For additional earthwork requirements near:
  - 1. Water Lines see 331000 - Water Utilities
  - 2. Sewer Lines see 333000 - Sanitary Sewerage Utilities
  - 3. Storm Lines see 334000 - Storm Drainage Utilities
- E. For additional earthwork requirements near proposed structures see Section 312000

#### 1.03 REFERENCES

- A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10 lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.
- B. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. ASTM C 117 - Method for Sieve analysis wet sieve
- D. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- E. ASTM D2487 - Classification of Soils for Engineering Purposes.

- F. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- G. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

#### 1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).
- B. Testing and analysis of soil material in accordance with testing schedule at the end of this specification section.
- C. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D1557/ AASHTO T180 and ASTM D2922.
- D. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D2487.
- E. If tests indicate materials do not meet specified requirements, change material and retest.
- F. Provide materials of each type from same source throughout the Work.
- G. Perform all work in accordance with recommendations included in the Geotechnical Report.

#### 1.05 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients. Provide three ties to all bends and structures.

#### 1.06 SUBMITTALS FOR REVIEW

- A. Division 1 - Submittals: Procedures for submittals.
- B. Samples: Submit proposed location of use, name of imported materials source, sieve analysis and proctor results performed in accordance with ASTM/1557 for each type of fill. Soil testing to be provided by testing laboratory accepted by engineer.
- C. Submit procedures for accomplishing dewatering work.

### Part 2 PRODUCTS

#### 2.01 MATERIALS

- A. Topsoil
  - 1. Excavated and reused material.
  - 2. Graded.
  - 3. Free of roots, rocks larger than 1/2-inch, subsoil, debris, large weeds and foreign matter.
  - 4. Conforming to ASTM D2487 Group Symbol OH.
  - 5. The organic content shall be not less than 2% or more than 20%.
  - 6. Sieve Designation                      Percent by weight passing
    - a. 2 inches                                      100



- b. 1 inch                      85 – 100
- c. 1/4 inch                    65 – 100
- d. #200                        20 – 80

- 7. The Contractor may amend natural topsoil with approved materials and by approved methods to meet the above specifications.
- 8. Frozen topsoil is not acceptable
- B. Aggregate Materials: As specified in Section 310516 - Aggregates for Earthwork. Frozen aggregates are not acceptable.
- C. Subsoil Excavation/Unclassified fill:
  - 1. See Geotechnical Report requirements for reuse of native on-site materials. Provide applicable testing if use is proposed.
  - 2. Satisfactory materials for unclassified or common fill comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, & SM. Satisfactory materials for grading comprise stones less than 8 inches, except for fill material located under the pavement or building which comprise stones less than 3 inches in any dimension.
  - 3. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, backfills from previous construction, and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Engineer when encountering any contaminated materials.
  - 4. Concrete: For use in pipe encasement or other non-structural and non-paving applications, concrete shall conform to Section 033000 with a compressive strength of 3000psi with 5 - 7% air entrainment.

## 2.02 ACCESSORIES

- A. Geotextile Fabric:
  - 1. Woven fabric for stability: Mirafi 160N or equivalent, as approved by Engineer.
  - 2. Non-Woven filter fabric for soil separation: Mirafi 140N or equivalent, as approved by Engineer.
- B. Buried Warning Tracer and Identification tape
  - 1. All on-site existing and proposed subsurface utility piping and conduits shall be provided with metallic tracer and identification tape.
  - 2. Provide metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection. Provide tape on rolls, 6 inches minimum width, 0.004 inches minimum thickness, 1500 psi lengthwise and 1250 psi crosswise color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length.

Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

3. Warning Tape Color Codes
  - a. Red: Electric
  - b. Yellow: Gas
  - c. Orange: Telephone and Other Communications
  - d. Blue: Water Systems
  - e. Green: Sewer Systems

### Part 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

#### 3.02 STOCKPILING

- A. Stockpile materials offsite.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

#### 3.03 PREPARATION

- A. Identify required lines, levels, contours, datum, and benchmark locations.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect from damage utilities that remain.
- D. Notify utility company and contracting officer prior to removing or relocating utilities.
- E. Protect above and below grade utilities that remain.
- F. Protect plant life, lawns, and other features remaining as a portion of final landscaping.
- G. Protect bench marks, existing structures, signs, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

#### 3.04 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas with proposed utility work, excavation, re-landscaping, or re-grading, or other proposed improvements, without mixing with foreign materials.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 12 feet and protect from erosion. Segregate topsoil from other soil, aggregates, materials, and debris.
- D. Remove deleterious material from site.

- E. Remove excess topsoil not intended for reuse, from site.
- F. Strip and stockpile organic topsoil material. If there is little to no topsoil in the proposed limits of disturbance, remove native vegetation, strip to a depth equal to 4 inches.

### 3.05 SUBSOIL EXCAVATION

- A. Underpin adjacent structures which may be damaged by excavating work. Do not interfere with 45 degree bearing splay of foundations.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Excavate subsoil to accommodate building foundations, slabs-on-grade, paving and site structures, and construction operations.
- E. Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation, and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches, or trenches within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. While the excavation is open, maintain the water level continuously, at least 1 foot below the working level.
- F. Do not excavate in the wet, below standing water subsoil. Grade top perimeter of excavating to prevent surface water from draining into excavation.
- G. When excavating through roots, perform work by hand and cut roots with sharp axe.
- H. Hand trim excavation. Remove loose matter.
- I. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
- J. Notify Architect/Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- K. Stockpile in area designated on site to depth not exceeding 12 feet and protect from erosion. Remove subsoil from site not being reused.
- L. Stability: Replace damaged, displaced, or over excavated subsoil to same requirements as specified for fill.
- M. Remove excess material not being used from site.

### 3.06 FILLING

- A. Install Work in accordance with State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).
- B. Cut out yielding soft areas of native subgrade. Backfill with granular backfill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Verify sub-drainage, damp-proofing, or waterproofing installation has been inspected.

- D. Place geotextile fabric over subbase prior to placing next lift of fill in parking lots and paved areas. Where backfill is a granular, well-draining material, adjacent to a material with fines (more than 6% passing the #200 sieve) the two materials shall be separated with filter fabric.
- E. Backfill against supported foundation, do not backfill against unsupported foundation unless directed by structural engineer. Verify structural ability of unsupported walls to support imposed loads by the fill. If allowed, backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- F. Employ a placement method that does not disturb or damage other work.
- G. Fill areas to proposed contours and elevations with unfrozen materials.
- H. Place fill material in continuous layers and compact in accordance with schedule at the end of this section. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- I. Maintain optimum moisture content of fill materials to attain required compaction density.
- J. Slope grade away from building at a minimum of 3% for the first 10 feet.
- K. Make grade changes gradual. Blend slope into level areas with minimum 10-foot transition.
- L. Remove surplus fill materials from site.

### 3.07 RIP-RAP CONSTRUCTION

- A. Construct rip-rap on filter fabric in the areas indicated. Trim and dress adjacent grades to match the elevation of the top of the rip-rap stones.

### 3.08 UTILITY MARKERS AND BURIED WARNING AND IDENTIFICATION TAPE

- A. Provide and install metallic identification tape, tracer wire, and for all new utility lines or existing line where the contractor has disturbed the existing warning or metallic identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.
- B. Provide and install utility line monument markers, ball markers, (concrete with brass identification plugs) every 200 feet along straight runs and at each change of direction.

### 3.09 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.
- B. Top Surface of Backfilling under Paved Areas: Plus or minus 1/10 foot from required elevations.
- C. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

### 3.10 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.
- B. If a borrow area is indicated, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.

**3.11 FIELD QUALITY CONTROL**

- A. Section 01400 - Quality Requirements: Field inspection and testing.
- B. Proof roll compacted fill surfaces under slabs-on-grade, paving, sidewalks, concrete pads.
- C. Testing: In accordance with ASTM D2922 and ASTM D3017.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- E. Frequency of Tests: See Schedule at end of section.

**3.12 SCHEDULES**

- A. Beneath and around footings, beneath slabs
  - 1. Compact to 95% maximum density, modified proctor.
  - 2. Maximum lifts of 12 inches loose measure before compaction.
  - 3. Frequency of Tests - Every 2000 square feet, every lift.
- B. Parking roadways and sidewalks
  - 1. Compact to 95% maximum density, modified proctor.
  - 2. Maximum lifts of 12 inches loose measure before compaction.
  - 3. Frequency of Tests - Every 2000 square feet, every lift.
- C. General Fill (below all lawn or vegetated areas):
  - 1. Compact to 90% maximum density, modified proctor.
  - 2. Maximum lifts of 12 inches compacted depth.
  - 3. Frequency of Tests - Every 2000 square feet, every lift.

END OF SECTION

## 312213 ROUGH GRADING

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Removal of topsoil and subsoil.
- B. Cutting, grading, filling, rough contouring, and compacting the site for site structures, roadways, parking lots, and equipment pads.

#### 1.2 RELATED SECTIONS

- A. Section 31 05 13 - Soils for Earthwork
- B. Section 31 10 00 - Site Clearing
- C. Section 31 23 16 - Excavating
- D. Section 31 23 33 - Trenching and Backfilling
- E. Section 31 25 00 - Erosion & Sedimentation Control

#### 1.3 REFERENCES

- A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10 lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.
- B. ASTM C136 - Method For Sieve Analysis of Fine and Coarse Aggregates.
- C. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- D. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- E. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

#### 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of DIVISION 1: Submittals
- B. Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients. Provide three ties to all bends and structures.

### PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Topsoil: As specified in Section 310513 Soils for Earthwork
- B. Aggregate Materials: As specified in Section 310516 Aggregates for Earthwork.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

### 3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect utilities that remain, from damage.
- D. Notify utility company and facilities staff prior to removing or relocating utilities.
- E. Protect above and below grade utilities that remain.
- F. Protect plant life, lawns, and other features remaining as a portion of final landscaping.
- G. Protect bench marks, existing structures, signs, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

### 3.3 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded.
- B. Do not excavate wet subsoil.
- C. When excavating through roots, perform work by hand and cut roots with sharp axe.
- D. Stockpile in area designated on site to depth not exceeding 12 feet and protect from erosion. Remove from site, subsoil not being reused.
- E. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

### 3.4 FILLING

- A. Install Work in accordance with State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).
- B. Fill areas to contours and elevations with unfrozen materials.
- C. Place fill material on continuous layers and compact in accordance with schedule at the end of this section.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum one percent, unless noted otherwise.
- F. Make grade changes gradual. Blend slope into level areas.

- G. Remove surplus fill materials from site.

### 3.5 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

### 3.6 FIELD QUALITY CONTROL

- A. DIVISION 1: Field inspection and testing.
- B. Testing: In accordance with ASTM D1557.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Frequency of Tests: See Schedule at end of section.

### 3.7 SCHEDULES

- A. All Fill Types: Structural Fill:
  - 1. Compact to minimum 95 percent of maximum density, modified proctor.
- B. Topsoil Fill:
  - 1. Maximum 6 inches compacted depth.
  - 2. Compact to minimum 90 percent of maximum density, modified proctor.
  - 3. Frequency of Tests: Every 1,000 square feet, every lift.

END OF SECTION



## **312316 EXCAVATION**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Excavating for building foundations.
- B. Excavating for slabs-on-grade, paving, landscaping, and utilities.
- C. Excavating for site structures.

#### **1.2 RELATED SECTIONS**

- A. Section 31 22 13 - Rough Grading
- B. Section 31 23 33 - Trenching and Backfilling
- C. Section 31 25 00 - Erosion & Sedimentation Control

#### **1.3 FIELD MEASUREMENTS**

- A. Verify that survey benchmark and intended elevations for the Work are as indicated.

### **PART 2 - PRODUCTS**

Not Used.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain from damage.
- C. Notify utility company prior to removing and relocating utilities.
- D. Protect plant life, lawns, and other features remaining as a portion of final landscaping.
- E. Protect benchmarks, survey control points, existing structures, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

#### **3.2 EXCAVATING**

- A. Underpin adjacent structures which may be damaged by excavating work.
- B. Excavate subsoil to accommodate building foundations, slabs-on-grade, paving and site structures, and construction operations.
- C. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 31 23 33 and 31 05 13.
- D. Slope banks with machine to slope shown on plans.
- E. Do not interfere with 45 degree bearing splay of foundations.

- F. Grade top perimeter of excavating to prevent surface water from draining into excavation.
- G. Hand trim excavation. Remove loose matter.
- H. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
- I. Notify Architect/Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- J. Correct areas over excavated in accordance with Section 31 23 33.
- K. Stockpile excavated material in area designated on site in accordance with Section 31 05 13.

### 3.3 FIELD QUALITY CONTROL

- A. DIVISION 1 - Quality Assurance: Field inspection and testing.
- B. Provide for visual inspection of bearing surfaces.

### 3.4 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION

## 312319 DEWATERING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes construction dewatering.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

#### 1.3 SUBMITTALS

- A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, discharge lines, piezometers, and flow-measuring devices; and means of discharge, control of sediment, and disposal of water.
- B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to dewatering including, but not limited to, the following:
    - a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
    - b. Geotechnical report.
    - c. Proposed site clearing and excavations.
    - d. Existing utilities and subsurface conditions.
    - e. Coordination for interruption, shutoff, capping, and continuation of utility services.
    - f. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - g. Testing and monitoring of dewatering system.

#### 1.5 PROJECT CONDITIONS

- A. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Engineer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

## PART 2 - PRODUCTS

Not used.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Provide temporary grading to facilitate dewatering and control of surface water.
- B. Monitor dewatering systems continuously.
- C. Protect and maintain temporary erosion and sedimentation controls, which are specified in 312500 Erosion and Sedimentation Control during dewatering operations.
- D. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
  1. Space well points or wells at intervals required to provide sufficient dewatering.
  2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- E. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- F. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
  1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- G. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
  1. Maintain piezometric water level a minimum of 60 inches below surface of excavation.
- H. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- I. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.

1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

J. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

### 3.2 FIELD QUALITY CONTROL

A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION

## **312333 TRENCHING AND BACKFILLING**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Building perimeter and site structure backfilling to subgrade elevations.
- B. Site filling and backfilling.
- C. Fill under slabs-on-grade.
- D. Fill under paving.
- E. Fill for over-excavation.
- F. Consolidation and compaction as scheduled.

#### **1.2 RELATED SECTIONS**

- A. Soil Borings: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. DIVISION 1: Compaction testing
- C. Section 31 05 13 - Soil For Earthwork
- D. Section 31 05 16 - Aggregates For Earthwork
- E. Section 31 23 16 - Excavation

#### **1.3 REFERENCES**

- A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.
- B. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- C. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- D. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- E. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

### **PART 2 - PRODUCTS**

#### **2.1 FILL MATERIALS**

- A. Fill Type: As specified in Section 310513 Soils for Earthwork and 310516 Aggregates for Earthwork.
- B. Concrete: Structural concrete conforming to Section 320523 with a compressive strength of 4,000 psi.

#### **2.2 ACCESSORIES**

- A. Geotextile Fabric: Mirafi 140N or equivalent, as approved by Engineer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify subdrainage, damp proofing, or waterproofing installation has been inspected.
- B. Verify structural ability of unsupported walls to support imposed loads by the fill.

#### **3.2 PREPARATION**

- A. Cut out yielding soft areas of subgrade. Backfill with granular backfill and compact to density equal to or greater than requirements for subsequent fill material.

#### **3.3 BACKFILLING**

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Place geotextile fabric over subbase prior to placing next lift of fill in parking lots and paved areas.
- D. All aggregate: Place and compact materials in equal continuous layers not exceeding 12 inches compacted depth.
- E. See Geotechnical Report requirements for reuse of native on site materials.
- F. Employ a placement method that does not disturb or damage other work.
- G. Maintain optimum moisture content of backfill materials to attain required compaction density.
- H. Backfill against supported foundation. Do not backfill against unsupported foundation unless directed by structural engineer.
- I. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- J. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise.
- K. Make gradual grade changes. Blend slope into level areas.
- L. Remove surplus backfill materials from site.
- M. Leave fill material stockpile areas free of excess fill materials.

#### **3.4 TOLERANCES**

- A. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.
- B. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

#### **3.5 FIELD QUALITY CONTROL**

- A. DIVISION 1: Field inspection and testing.
- B. Compaction testing will be performed in accordance with ASTM D2922 and ASTM D1557.

Compaction to meet 95% modified proctor.

- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Frequency of Tests: Every layer and every 1,000 square feet.
- E. Proof roll compacted fill surfaces under slabs-on-grade, paving, sidewalks, concrete pads.

### 3.6 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic.

### 3.7 SCHEDULE

- A. Beneath and around footings, beneath slabs
  - 1. Compact to 95% maximum density, modified proctor.
  - 2. Maximum lifts of 12 inches loose measure before compaction.
  - 3. Frequency of Tests - Every 2000 square feet, every lift.
- B. Parking roadways and sidewalks
  - 1. Compact to 95% maximum density, modified proctor.
  - 2. Maximum lifts of 12 inches loose measure before compaction.
  - 3. Frequency of Tests - Every 2000 square feet, every lift.
- C. General Fill (below all lawn or vegetated areas):
  - 1. Compact to 90% maximum density, modified proctor.
  - 2. Maximum lifts of 12 inches compacted depth.
  - 3. Frequency of Tests - Every 2000 square feet, every lift.

END OF SECTION



## 312500 EROSION AND SEDIMENTATION CONTROL

### Part 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Stabilization Practices.
- B. Structural Erosion and Sediment Practices.

#### 1.02 REFERENCES

- A. ASTM D2487 - Classification of Soils for Engineering Purposes.
- B. EPA 2022 Construction General Permit (CGP)

#### 1.03 SUBMITTALS FOR REVIEW

- A. Samples: Submit sieve analyses and proctors for each type of fill. Soil testing to be provided by testing laboratory accepted by engineer.
- B. Product Data: Submit data on materials to be used.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. EPA 2022 CGP Notice of Intent (NOI)
- E. All EPA 2022 CGP Inspection Reports
- F. All EPA 2022 CGP Corrective Action Reports
- G. EPA 2022 CGP Notice of Termination (NOT)

#### 1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).
- B. Perform Work in accordance with State of New Hampshire Department of Environmental Services' "New Hampshire Stormwater Management Manual, Volume 3, Construction Phase Erosion and Sediment Controls," latest revised.
- C. Provide products and perform work in accordance with "New Hampshire Stormwater Management Manual" published by New Hampshire Department of Environmental Services last revised 2008.
- D. Contractor shall function as and meet all requirements for eligibility as an operator as defined by the CGP.
- E. Contractor shall be responsible for proper installation, monitoring, maintenance, and removal of all temporary erosion control measures and taking precautionary steps to avoid any sediment transfer to neighboring sites or waters of the state as required by the submitted SWPPP and the CGP.

### Part 2 PRODUCTS

2.01 MATERIALS

- A. Non-woven Filter Fabric: Mirafi 140N, Mirafi 160N, or equivalent.
- B. Woven Filter Fabric: Mirafi 500X or equivalent.
- C. Erosion Control Matting:
  - 1. Slope less than 2.5:1 North American Green SC150BN, or equal.
  - 2. Slopes greater than 2.5:1: North American Green C125, or equal
- D. Mulch: Straw which is air-dried and free of undesirable seeds and coarse materials shall be utilized. Hay may not be used.
- E. Straw Wattles:
  - 1. Interior: 100% Weed-Free Straw Matrix
  - 2. Exterior: 0.5 in. x 0.5 in. HD Synthetic, Photodegradable Netting
  - 3. Cylindrical Configuration with closed ends
- F. Woven wire fabric (14 Ga. Min) 6"x6"
- G. Solid Oak Posts 2"x2x30" Long

2.02 ACCESSORIES

- A. Materials shall be in accordance with "New Hampshire Stormwater Management Manual" published by New Hampshire Department of Environmental Services last revised 2008.

Part 3 EXECUTION

3.01 LIMITS OF DISTURBANCE (LOD) should be the first construction item implemented on a construction site. All disturbance areas bordering areas of existing vegetation should be demarcated with a barrier appropriate to the location.

- A. Flagging Ribbon/Paint: for use where proposed disturbance borders established wooded areas where inadvertent disturbance by machinery is not possible. Mark trees along limit of clearing with flagging ribbon or paint corresponding to clearing limits on the authorized EPSC Plan.
- B. Barrier Tape/Rope: for use where proposed disturbance borders non-wooded, vegetated areas more than 100 ft from the nearest water resource (stream, brook, lake, pond, wetland, etc.). Barrier tape is high visibility fiberglass tape, minimum 3" in width commonly used in ski areas for demarcating closed areas. Barrier tape and rope should be attached to stakes, at a minimum height of 4 ft from the ground.
- C. Construction Fence / Snow Fence / Boulders: for use where the proposed disturbance is within 100 ft of a water resource (stream, brook, lake, pond, wetland, etc.), unless the area is densely wooded. Fence should be continuous and prevent access to buffer areas by machinery. Boulders must be spaced closely so as to prevent machinery access.

3.02 MULCHING

- A. All disturbed surfaces shall be temporarily or permanently seeded and mulched within 7 days of disturbance.
- B. Seeding and mulching of disturbed areas shall take place within 48 hours of final grading.
- C. Mulch: Straw which is air-dried and free of seeds and coarse materials shall be utilized. Apply mulch at a rate of 90-100 lbs/1,000 sf. Mulch shall cover more than 90% of the surface. Hay may not be used.
- D. Mulch shall not be placed on slopes of greater than 3:1. Seed impregnated erosion control netting shall be used in its place.
- E. Seed: seeding shall occur after April 15 and prior to September 15th in order to establish a stand of grass prior to ground freezing. Seed shall be in accordance with seed specification on EPSC Plan.
- F. Cover seed with 1/4 inch soil unless a hydroseeder is used.
- G. Mulch anchoring: Use a mulch anchoring tool (blunt, straight discs) which shall be pulled over the mulch. Use degradable mulch netting when slopes are greater than 10%. Install in accordance with rolled erosion control product.
- H. Topsoil and mulching not to be applied in areas of travel ways.

### 3.03 EROSION CONTROL MATTING

- A. Erosion control matting shall be installed in:
  - 1. All locations where it is indicated on the plans.
  - 2. In all locations where the proposed slope is greater than 10%.
  - 3. In all locations that require temporary stabilization where the slope is greater than 10%.
- B. Mats or blankets shall be installed vertically downslope.
- C. Mats or blankets shall be overlapped a minimum of 4". The uphill blanket shall overlap the downhill blanket.
- D. Blankets shall be anchored in accordance with the manufacturer's recommendations, with a minimum staple size and spacing as shown on the drawings.
- E. Slope surface shall be free of rocks, clods, sticks, and grass. Mats and blankets shall have good soil contact.
- F. Apply permanent seeding before placing mats or blankets.
- G. Lay mats and blankets loosely and stake or staple to maintain direct contact with the soil. Do not stretch.

### 3.04 CHECK DAM

- A. Type I Stone Fill will be placed on Mirafi 500X filter fabric foundation to the lines, grades and locations shown in the design drawings.
- B. Set spacing of check dams to assume that the elevation of the crest of the downstream dam is at the dame elevation of the toe of the upstream dam.

- C. Extend the stone a minimum of 1.5 feet beyond the ditch banks to prevent cutting around the dam.
- D. Remove sediment collected behind each dam when depth of sediment is one half the height of the dam.

3.05 TEMPORARY SWALE

- A. Construct a temporary swale in the locations shown on the design drawings.
- B. All temporary swales shall have uninterrupted positive grade to an outlet.
- C. Diverted runoff from a disturbed area shall be conveyed to a sediment trapping device.
- D. All trees, brush, stumps, obstructions, and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the swale.
- E. The temporary swale shall be excavated and shaped to line, grade, and cross section as shown on the project drawings for a grassed drainage swale.

3.06 SILT FENCE

- A. Construct silt fence in locations as shown on plans.
- B. Construct to the maximum extent possible parallel to the existing grade.
- C. Silt fence shall be pre-fabricated erosion control fence by Mirafi or equal, or constructed in place.
- D. Woven wire fence to be fastened securely to fence posts with wire ties or staples.
- E. Filter fabric to be fastened securely to woven wire fence ties spaced every 24" at top of mid-section.
- F. When two sections of filter cloth adjoin each other, they shall be overlapped by 6", folded and stapled.
- G. Inspection shall be frequent (minimum once a week and after every rainfall). Maintenance shall be performed as needed, and sediment removed when "bulges" develop in silt fence.
- H. The bottom 18" of fabric shall be buried a depth of 8" with backfill soil placed on top of the fabric.
- I. Posts shall be embedded a minimum of 18"

3.07 CATCH BASIN PROTECTION DEVICE

- A. Clear the area of all debris that will hinder excavation.
- B. Grade approach to the inlet uniformly around the basin.
- C. Weep holes shall be protected by gravel.
- D. Upon stabilization of contributing drainage area, seal weep holes, fill basin with stable soil to final grade, compact it properly and stabilize with permanent seeding.
- E. Gravel bags, grate guards, Filtrexx, or Sediguard inlet protection devices may be used. Submit product information to Engineer for review prior to use. Install products in

accordance with the manufacturer's instructions and the latest edition of the "New Hampshire Stormwater Management Manual".

3.08 CONSTRUCTION ENTRANCE

- A. Install where located on plans and in all locations where vehicles leave the site.
- B. Install in accordance with the dimensions shown on the construction plans.
- C. Stone size: use Type 1 Stone Fill. Place stone over Mirafi 500X Filter Fabric.
- D. Surface water: all surface water flowing or diverted toward construction entrance shall be piped across the entrance.
- E. Maintenance: the entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand. Repair and/or cleanout any measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto public rights-of-way must be removed immediately.
- F. Wheels shall be cleaned to remove mud prior to entrance onto public right-of-way. When washing is required, it shall be done on an area stabilized with stone which drains into an approved sediment trapping device.

3.09 TEMPORARY SEDIMENT TRAP

- A. The volume of sediment storage shall be 3,600 cf per acre of contributory drainage. Minimum volumes and outlet sizes for each trap are listed in the sediment trap schedule shown on the plans.
- B. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one-half of the design depth of the trap. Removed sediment shall be deposited in a suitable area and stabilized.
- C. All embankments for sediment traps shall not exceed 5 feet in height as measured at the low point of the original ground along the centerline of the embankment.
- D. Embankments shall have a minimum 4-foot-wide top and side slopes of 2:1 or flatter. The embankment shall be compacted by traversing with equipment while it's being constructed.
- E. Any excavated portion of sediment trap shall have 2:1 slopes or flatter.
- F. Area under embankment shall be cleared, grubbed, and stripped of any vegetation and root mat. The pool area shall be cleared.
- G. The fill material for the embankment shall be free of roots or other woody vegetation as well as oversized stone, rocks, organic material, or other objectionable material. The embankment shall be compacted by traversing with equipment while it is being constructed.
- H. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.
- I. The structure shall be removed and area brought to final grade and stabilized when the drainage area has been properly stabilized.

- J. Fill material around the pipe spillway shall be hand compacted in four (4) inch layers. A minimum of two (2) feet of hand compacted backfill shall be placed over the pipe spillway before crossing it with construction equipment.

END OF SECTION

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## 320100 KUA TREE AND PLANT PROTECTION

### 1. SUMMARY

Protection of existing trees and plants from damage as a result of the Contractor's operations including, but not limited to:

1. Protection of trees and plants themselves.
2. Marking of clearing limits.
3. Vegetation protective signage.
4. Tree protection fencing.
5. Boxing of tree trunks.
6. Root pruning and construction pruning.

Examine Contract Documents for requirements that affect work of this Section, specifically Civil Engineering drawings. Other Specification Sections that directly relate to work of the Section include, but are not limited to:

329300 Trees, Plants, and Ground Covers

#### A. REFERENCES:

Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

- i. American National Standards Institute (ANSI):  
Z133.1 Safety Requirements for Pruning, Trimming, Repairing, Maintaining and Removing Trees, and for Cutting Brush
- ii. International Society of Arboriculture (ISA):  
Guide for Establishing Values of Trees and Other Plants
- iii. National Arborist Association (NAA):  
Ref. 1 Pruning Standards for Shade Trees

#### B. DAMAGE PENALTIES

- i. Damage to trees on the property will be assessed at the rate of \$200 per inch caliper of the tree.
- ii. A fine of \$1,000 will be levied against the Contractor for each incident of construction inside tree protection areas without prior notification and agreement from the architect and Owner.
- iii. Damages to trees, shrubs, and other vegetation will be assessed by the Architect and Owner in accordance with the ISA Guide.
- iv. Trees or roots visibly damaged will cause the Owner to withhold from the Contractor an assessed amount conforming to the requirements stipulated above for a period of two years. After that period the impact of the damaged to any tree will be assessed accordingly.
- v. If any trees or shrubs designated to be saved are damaged and replacement is required, a number and diameter of trees or shrubs of the same species and variety, as specified by the Owner and Architect, shall be furnished and planted by the Contractor. The total inch diameter of the replacement trees or shrubs shall equal

the diameter of the tree or shrub to be replaced. The Contractor shall not be liable for any loss or damage which occurs while the Contractor is complying with instructions given by the Owner, Architect, or arborist working on the Project.

2. SUBMITTALS

The following are required as part of the submittal for these products:

Submittal	Req.	Specifics
Shop Drawings	x	Identify trees in need of protection and define strategy for protection.
Product Cut Sheets		
Product Samples		
Mock-ups	N/A	
Closeout submittals	N/A	

General: Refer to section 011000, SUMMARY AND GENERAL REQUIREMENTS FOR SUBMITTAL PROVISIONS AND PROCEDURES.

Proposed methods, and schedule for effecting tree and plant protection shall be submitted for approval.

Proposed methods, materials, and schedule for root pruning, construction pruning, and tree fertilization shall be submitted for approval.

3. PRODUCTS

A. TREE PROTECTION FENCING

Tree protection fencing shall be one of the following, at the Contractor’s option.

- i. Wire bound wood-roll snow fence 4 feet high minimum, with 3/8 inch x 1-1/2 inch wide pickets, spaced approximately 2 inches apart bound together with at least 13 gauge galvanized steel wire.
- ii. Galvanized chain link fencing, 4 feet high.
  - a. Stakes for fencing shall be 8 feet galvanized steel posts, driven a minimum of 3 feet into the ground. Posts shall be spaced 10 feet on center maximum.
- iii. Plastic polymer safety fence, Model BX2050 Safety Grid, manufactured by The Tensar Corporation, Marrow, GA 30260, or approved equal. Color shall be high visibility orange.
  - a. Stakes for fencing shall be 2 inch x 4 inch wood posts, 7 feet in length, driven a minimum of 3 feet into the ground. Posts shall be spaced 8 feet on center maximum.

B. ROOT PRUNING

- i. Peat moss and mulch materials shall be as specified under Section 329300, TREES PLANTS, AND GROUND COVERS.



- ii. Liquid fertilizer to be applied to root pruned and construction pruned trees shall be Peters M 77 Sequestered-Chelated Soluble Fertilizer manufactured by W. R. Grace and Co., Cambridge, MA 02140, or approved equal.
- iii. Dormant oil spray shall be a dormant miscible spray equal to Volck Oil, manufactured by Ortho.
- iv. Insecticide shall be Isotox manufactured by Ortho or approved equal.

4. EXECUTION

A. SPECIAL SITE LIMITATIONS

- i. Existing trees as noted to remain shall be protected to ensure they remain untouched and unharmed.
- ii. Clearly mark all clearing limits in the field and accompany Architect on a joint review of clearing limits before clearing operations have commenced. Limit of clearing is generally defined as the limit of grading.

B. INSTALLATION OF FENCING

- i. Prior to start of demolition work and clearing and grubbing operations, tree protection fencing shall be installed in accordance with the following:
  - a. Fencing shall be installed at the trees noted as existing to remain as indicated on the Drawings.
  - b. Fencing shall be installed a minimum of 15 feet beyond the drip line of the trees to be protected, unless otherwise approved by the Architect.

C. ROOT PRUNING

- i. Where construction will be in close proximity to existing trees designated to remain, roots shall be pruned. Proximity shall be as determined in the field by the Architect or Arborist.
- ii. Root pruning is the physical cutting of tree roots to minimize root damage and promote healing. Suitable means for root pruning include, but are not limited to, trenching, vibrating plow, and stump grinder. Any method which tears roots or disturbs the soil beyond the grading limit is unacceptable.
- iii. Tree to be root pruned shall be root pruned to a depth of 24 inches by means of a trencher, backhoe, or other approved means.
- iv. Backfill root pruning trench with existing soil mixed with peat moss or well-rotted sawdust to a mixture of approximately 75% soil and 25% humus. Tamp lightly to set soil.
- v. Apply mulch to a depth of 4 inches to 6 inches at a minimum of 10 to 15 feet radius around tree to reduce compaction and increase moisture retention.

D. CONSTRUCTION PRUNING

- i. To compensate for root zone damage for cut or fill earthwork operations, prune top of tree by approximate percent of root zone area that has been damaged as directed by Architect or Arborist.
- ii. Construction pruning shall consist of pruning the tree crown to compensate for root zone damage due to construction operations. Construction pruning shall include a

fertilization/ insecticide program. Tree crown should be pruned by the approximate percent of the root zone that has been damaged.

- iii. Construction pruning shall conform to NAA Ref. 1 for Class IV – Crown Reduction Pruning. Work shall conform to the requirements of ANSI Z133. 1.
- E. FERTILIZATION AND INSECT SPRAYING
- i. Root pruned and construction pruned trees shall be treated with liquid fertilizer, dormant oil spray, and insecticide.
  - ii. Liquid fertilizer shall be applied at a rate recommended by the manufacturer and as required by NAA Ref. 2.
  - iii. Dormant oil spray shall be applied in early spring before buds begin to swell at a rate recommended by the manufacturer.
  - iv. Insecticide spray shall be applied twice to root pruned trees following application of dormant oil spray. Spray insecticide at rates recommended by spray manufacturer at intervals appropriate for effective insect control.
- F. CLEARING WITHIN PROTECTION AREAS
- i. Selective clearing within tree protection areas shall only be performed when and as directed by the Architect.
- G. REMOVAL OF PROTECTION
- i. Except as otherwise indicated or requested by Architect, temporary protection devices and facilities installed during course of the work shall be removed only after all work which may injure or damage trees and plants is completed.

END OF SECTION 320100 KUA TREE AND PLANT PROTECTION

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## 321200 BITUMINOUS ASPHALT PAVING

### PART 1.00 - GENERAL

#### 1.01 SUMMARY

- A. Work covered by this Section includes the furnishing and installation of asphalt concrete paving, gravel shoulders, painting, and pavement marking. Required pavement sections are shown on the Drawings.
- B. Definitions:  
NHDOT Spec. - New Hampshire Department of Transportation, Standard Specifications for Road and Bridge Construction including all addenda.
- C. Section Includes:
  - 1. Cold milling of existing asphalt pavement.
  - 2. Hot-mix asphalt patching.
  - 3. Hot-mix asphalt paving.
  - 4. Hot-mix asphalt overlay.
  - 5. Asphalt curbs.
- D. Related Requirements:
  - 1. Section 31 05 16 - Aggregates for Earthwork
  - 2. Section 31 20 00 - Earth Moving

#### 1.02 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by NHDOT.
- B. Installer Qualifications: Provide at least one person who shall be present at all times during the execution of this portion of the Work and who shall be thoroughly trained and experienced in the placing of the type of asphalt pavement specified and who shall direct all work performed under this Section. This person shall be responsible for checking temperatures of material arriving on-site as well as being placed. They will also be responsible for verifying Quality Control procedures are being followed by the paving crew.
- C. Use only personnel thoroughly trained and experienced in the skills required for installing and finishing asphalt concrete pavements and in operating the required equipment.
- D. All pavement work will be subject to quality control testing as specified by the Owner.
- E. All testing shall be performed by the approved testing laboratory. Engineer may use the testing laboratory for inspection services. One asphalt core sample is required per lane per street per placement day. Core sampling and results shall be in accordance with NHDOT requirements.
- F. Use only the materials and job-mix formula(s) approved by the Engineer.
- G. Obtain materials from same source throughout
- H. Regulatory Requirements: Perform Work in accordance with State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).

**1.03 SOURCE QUALITY ASSURANCE**

- A. All materials and the asphalt plant will be subject to observation and tests by Engineer and by the approved testing laboratory. Provide all equipment, materials, facilities and labor as specified in NHDOT Spec. Section 401.

**1.04 JOB-MIX FORMULA**

- A. Do not commence paving until job-mix formula(s) has been submitted and approved by the Engineer. The required job-mix formula(s) shall comply with NHDOT Spec. Section 401.
- B. Provide all testing as required to clearly show that materials meet Specification requirements.

**1.05 SUBMITTALS**

- A. All submittals shall conform to Section 01 33 00 Submittal Procedures.
- B. Product Data: The Design Information Shall Include:
  - 1 Asphalt binder
  - 2 PG test data
  - 3 Specific gravity
  - 4 Laboratory Mix/Compaction Temperature
  - 5 Aggregate
  - 6 Dry and washed Gradation
  - 7 Bulk and Apparent Specific Gravity
  - 8 All appropriate consensus properties
  - 9 Moisture susceptibility according to AASHTO T 283.
- C. The proposed mix designs and materials shall be submitted to the Engineer a minimum of 20 working days before placement for approval. It shall be the responsibility of the Contractor to ensure all approved mix designs have been entered into the plant automation system before production begins.
- D. Name, address, and telephone number of the asphalt plant proposed for use and a certification that the plant conforms to the requirements of these Specifications.

**1.06 SCHEDULING**

- A. Coordinate work with the work of other Sections to avoid delays and damage.
- B. Notify the Engineer at least 48 hours in advance of the placing of any materials under this Section.
- C. Schedule work and operations to allow ample time for testing and observation. Cooperate with Engineer and the testing laboratory and provide access to all phases of the Work.
- D. Place temporary pavement within 21 days after backfilling and compaction has been completed.

**1.07 JOB CONDITIONS**

- A. Comply with the requirements concerning weather limitations as specified in NHDOT Spec. Section 401.

- B. Install permanent asphalt pavements between May 1 and November 1st, and then only when environmental conditions are satisfactory.

## PART 2.00 - PRODUCTS

### 2.01 MATERIALS

- A. Binder Mix (Base Course) - Bituminous Concrete, 3/4" Binder Mix, NHDOT Spec. Sections 401 and 403. (Minimum thickness 2 1/2 inch)
- B. Wearing Mix (Wearing Course) - Bituminous Concrete, 1/2" Wearing Mix, NHDOT Spec. Sections 401 and 403. (Minimum thickness depth 1 1/2 inch)
- C. Temporary Pavement - Bituminous Concrete, 1/2" Wearing Mix, NHDOT Spec. Section 403; one 2 inch course to provide a 2 inch total thickness min..
- D. Shoulders – NHDOT 304.33 or as specified on the Drawings.
- E. Other Materials - Materials not specifically described but required for complete and proper installation of pavements and shoulders, shall be as selected by Contractor, subject to the approval of the Engineer.
- F. Sidewalk Wearing Course - Bituminous Concrete, 3/8" Wearing Mix, NHDOT Spec. Section 401 and 403.

### 2.02 MIXES

- A. Recycled Content of Hot-Mix Asphalt: Meeting requirements of NHDOT Section 401.2.10
- B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by NHDOT and complying with Section 2.01.

### 2.03 TACK COAT

- A. Material for tack coat shall conform to NHDOT Spec. Division 400.
- B. A tack coat shall be applied immediately prior to placement of pavement. The rate of application of emulsified asphalt shall be between 0.02 and 0.05 gal/sy as determined by the Engineer depending on the relative absorbance and texture of the pavement surface.
- C. Bituminous material shall be uniformly applied with an approved applicator. When ordered, a pressure distributor shall be used. The tack coat shall be applied in such a manner as to offer the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the bituminous material.
- D. The existing surface shall be patched and shall be free of irregularities to provide a reasonably smooth and uniform surface to receive the treatment. Unstable corrugated areas shall be removed and replaced with suitable patching materials. The edges of existing pavements that are to be adjacent to new pavement shall be cleaned to permit the adhesion of bituminous materials.
- E. All abutting edges and joints within trench patching must have tack coat applied.
- F. Any bituminous material splashed or sprayed onto exposed surfaces of curbs, sidewalks, or other masonry structures shall be removed by sandblasting at the Contractor's expense.

#### 2.04 HOT POURED CRACK SEALANT

- A. This work shall consist of filling the major cracks in the pavement with an approved sealant material. The cracks to be filled will be those designated by the Engineer.
- B. Material shall be of the hot-poured type and be a product as included on the NHDOT Qualified Products List.
- C. Material not covered by an asphalt pavement overlay shall meet the requirements of AASHTO M324 (ASTM D6690) Type II.
- D. Material covered by an asphalt pavement overlay shall be low modulus conforming to AASHTO M324 (ASTM D6690) Type IV except cone penetration shall be 110150.
- E. All work must be in accordance with NHDOT Spec. Division 411.

#### PART 3.00 - EXECUTION

##### 3.01 INSPECTION

- A. Prior to the work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete, tested, and approved by Engineer and to the point where this installation may be properly performed. Particular attention shall be given to items such as pipelines to avoid excavating pavements at a later date.
- B. Verify that subgrades have been properly prepared, dry, and in suitable condition to begin paving.
- C. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph
  - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
  - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- D. Do not proceed with installations until conditions are satisfactory.

##### 3.02 INSTALLATION OF GRAVEL BASE COURSE

- A. Install base courses in accordance with Section 31 23 16 Excavating and Section 31 20 00 Earth Moving.
- B. Compaction requirements:
  - 1 95% maximum density, modified proctor.
  - 2 Maximum lifts of 12 inches loose measure before compaction.
  - 3 Frequency of Tests - Every 2000 square feet, every lift.to a minimum density of 95%.

##### 3.03 INSTALLATION OF GRAVEL SHOULDERS

- A. Shoulder shall rest upon the gravel base course and shall not block the flow path of water through the gravel base.
- B. Compaction requirements:

- 1 95% maximum density, modified proctor.
- 2 Maximum lifts of 12 inches loose measure before compaction.
- 3 Frequency of Tests - Every 2000 square feet, every lift.to a minimum density of 95%.

### 3.04 COLD PLANING BITUMINOUS SURFACES

- A. This work shall consist of the removal of existing bituminous pavement, by planing or milling type equipment, to the depth and grade shown on the plans or ordered by the Engineer.
- B. The existing bituminous surface shall be removed by a planing or milling machine capable of removing, in one or more passes, bituminous material to the depth specified. The equipment shall be capable of accurately establishing profile grades by an automatic grade control system referencing from either the existing pavement or from an established independent grade line.
- C. The equipment shall have an effective means for controlling dust.
- D. Milled material not designated for salvage shall become property of the Contractor and shall be removed and disposed of in an approved manner.
- E. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
  1. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
  2. Control rate of milling to prevent tearing of existing asphalt course.
  3. Repair or replace curbs, manholes, and other construction damaged during cold milling.
  4. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
  5. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
  6. Transport milled hot-mix asphalt to asphalt recycling facility.
  7. Keep milled pavement surface free of loose material and dust
- G. Prior to reopening the area to traffic, all equipment shall be removed to a location where it does not present a hazard to traffic and the pavement shall be cleaned by sweeping or flushing.
- H. The Contractor is responsible for protecting all existing structures from damage during milling operations.
- I. Milled taper dimensions shall be in accordance with NHDOT standards.

### 3.05 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Re-compact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseal concrete pieces firmly.
  1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated.

- Cut excavation faces vertically. Re-compact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 gal./sq. yd..
    - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
    - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
  - D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

### 3.06 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
- D. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.02 to 0.05 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.
  - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
  - 2. Protect primed substrate from damage until ready to receive paving.
- E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.02 to 0.05 gal./sq. yd.
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### 3.07 PLACING HOT-MIX ASPHALT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
  - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
  - 2. Place hot-mix asphalt surface course in single lift.
  - 3. Spread mix at a minimum temperature of 250 deg F.
  - 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
  - 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.



- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
  - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.08 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
  - 1. Clean contact surfaces and apply tack coat to joints.
  - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
  - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
  - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

### 3.09 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
  - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct lay down and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
  - 1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.10 ASPHALT CURBS

- A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F.
  - 1. Asphalt Mix: Same as pavement surface-course mix.
- B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

### 3.11 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  - 1. Base Course: Plus or minus 1/4 inch.
  - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: 1/4 inch.
  - 2. Surface Course: 1/8 inch.
  - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

### 3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979
  - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
  - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
    - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
    - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- E. Replace and compact hot-mix asphalt where core tests were taken.

- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

### 3.13 WASTE HANDLING

- A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

### 3.14 FIELD QUALITY CONTROL

- A. Except where otherwise specified, Engineer will select the date, time, location, number and type of tests required. Coordinate all testing as required in Section 01 40 00 Quality Requirements and provide full cooperation and assistance. All sampling and testing shall be done in the presence of Engineer.
- B. Run gradations of gravel base and gravel shoulders and for all other materials which may be proposed. Provide additional gradations when previous gradations do not meet Specification requirements and when a new source of material is proposed.
- C. Laboratory maximum density tests and field compaction density tests will be made in accordance with Section 31 23 23.23 Compaction. Asphalt compaction parameters shall comply with NHDOT specifications. If compaction or required thickness does not meet the required NHDOT or Contract parameters, the City may require adjustment in cost or replacement of the work.
- D. Traffic shall be limited to access on newly paved surfaces until surface temperatures are a maximum of 140 degrees. The Contractor is responsible for control of all traffic and preventing any damage, marking, cracking, or deformation caused by traffic. If damaged is observed the Contractor is responsible for repair or replace at their own expense.

### 3.15 ADJUST AND CLEAN

- A. When specified conditions and tolerances are not met, do all work required to correct the deficiencies in a manner approved by Engineer.
- B. If any irregularities or defects remain after compaction is completed, the entire affected area of the surface course shall be promptly removed and sufficient new material placed to form a true and even surface. Roll all minor surface projections, joints and minor honeycombed areas to a smooth finish. The final surface shall be of uniform texture conforming to the line, grade and cross section shown on the Drawings.
- C. If settlement occurs, do all work required to eliminate the settlement.
- D. Replace all asphaltic concrete where cores and samples were taken and blend in with surrounding pavement.
- E. Clean all paved surfaces of dirt, stones, and other debris and remove and dispose of off-site all discarded mix, boards, trash, and all other debris.

### 3.16 GUARANTEE

- A. The Contractor shall maintain pavement under this Contract during the guarantee period of one year from the date of Final Completion.

- B. If settlement holes or defects appear in the pavement, the Contractor shall have one week after notification by the Engineer, or owner to make satisfactory repairs. If repairs made are unsatisfactory to the Engineer and the owner, the owner may do the work or have the work done by others and the cost of such repairs will be charges to the Contractor. In the case of unsatisfactory repairs, the Contractor will be given one week notice to correct work before the owner completes the repairs.

END OF SECTION

## 321216 ASPHALT PAVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Cold milling of existing asphalt pavement.
  - 2. Hot-mix asphalt patching.
  - 3. Hot-mix asphalt paving.
  - 4. Hot-mix asphalt overlay.
  - 5. Asphalt curbs.
- B. Related Requirements:
  - 1. Section 31 05 16 - Aggregates for Earthwork
  - 2. Section 31 20 00 - Earth Moving

#### 1.2 REFERENCES

- A. The State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).

#### 1.3 ACTION SUBMITTALS

- A. Product Data: The Design Information Shall Include:
  - 1. Asphalt binder
  - 2. PG test data
  - 3. Specific gravity
  - 4. Laboratory Mix/Compaction Temperature
  - 5. Aggregate
  - 6. Dry and washed Gradation
  - 7. Bulk and Apparent Specific Gravity
  - 8. All appropriate consensus properties
  - 9. Moisture susceptibility according to AASHTO T 283.
- B. The proposed mix designs and materials shall be submitted to the Engineer a minimum of 20 working days before placement for approval. It shall be the responsibility of the Contractor to ensure all approved mix designs have been entered into the plant automation system before production begins.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each paving material. Mixes containing recycled materials shall perform equal to mixes produced from all new materials.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by NHDOT.
- B. Installer Qualifications: Imprinted-asphalt manufacturer's authorized installer who is trained and approved for installation of imprinted asphalt required for this Project.

- C. All pavement work will be subject to quality control testing as specified by the Owner
- D. Obtain materials from same source throughout.
- E. Retain "Manufacturer Qualifications" Paragraph below if required.
- F. Regulatory Requirements: Perform Work in accordance with State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
  - 1. Prime Coat: Minimum surface temperature of 60 deg F.
  - 2. Tack Coat: Minimum surface temperature of 60 deg F.
  - 3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
  - 4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
  - 5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. Stockpiled coarse aggregate shall meet the requirements of NHDOT Section 401.2 Table 2

Table 2 -Percent Passing				
Sieve Size	Base Mix 1-1/2 in. (37.5 mm)	Binder Mix 3/4 in. (19 mm)	Wearing Mix 1/2 in. (12.5 mm)	Wearing Mix 3/8 in. (9.5 mm)
1-1/2 in. (37.5 mm)	100			
1-1/4 in. (31.5 mm)	90.0 - 100			
1 in. (25.0 mm)	50.0 - 85.0	100		
3/4 in. (19.0 mm)	10.0 - 50.0	90.0 - 100	100	
1/2 in. (12.5 mm)		15.0 - 55.0	90.0 - 100	100
3/8 in. (9.5 mm)			20.0 - 60.0	95.0 - 100
No. 4 (4.75 mm)				22.0 - 55.0
No. 8 (2.36 mm)	0 - 5.0	0 - 5.0	0 - 10.0	0 - 10.0

## 2.2 ASPHALT MATERIALS

- A. Bituminous materials used for asphalt cement binder (including crack filler) shall meet the properties specified in NHDOT Section 401 and AASHTO M 320.
- B. The bituminous wearing course shall be NHDOT 12 mm Superpave Wearing Course, 50 Gyration Design, NHDOT Standard Specifications Section 401.
- C. The bituminous base course shall be NHDOT 19 mm Superpave Wearing Course, 50 Gyration Design, NHDOT Standard Specifications Section 401.
- D. Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-30.
- E. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

## 2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
- C. Joint Sealant: ASTM D 6690, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.
- D. Joint Adhesive: Shall be a product of the NHDOT Qualified Products List:
  - 1. Crafcoc Pavement Joint Adhesive, by Crafcoc Inc.
  - 2. Dura-Fill CJA, by P&T Products, Inc.
- E. Pavement markings shall be made from normal type reflectorized paint in standard colors per NHDOT specifications. All colors are to be approved by the Owner's representative.
  - 1. Colors
    - a. White- parking stripes, crosswalk stripes, and safety markings.
    - b. Yellow – roadway markings.
    - c. Blue and white- handicapped markings.

## 2.4 MIXES

- A. Recycled Content of Hot-Mix Asphalt: Meeting requirements of NHDOT Section 401.2.10
- B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by NHDOT and complying with the following requirements:
  - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
  - 2. Base Course: 3/4" Binder Mix, NHDOT Item 401 Section 2.6.1 Table 2
  - 3. Surface Course: 1/2" Wearing Mix, NHDOT Item 401 Section 2.6.1 Table 2

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
  - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
  - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.
- D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

### 3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
  - 1. Mill to a depth of 1-1/2 inches.
  - 2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
  - 3. Control rate of milling to prevent tearing of existing asphalt course.
  - 4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
  - 5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
  - 6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
  - 7. Transport milled hot-mix asphalt to asphalt recycling facility.
  - 8. Keep milled pavement surface free of loose material and dust.

### 3.3 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Re-compact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseal concrete pieces firmly.
  - 1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Re-compact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 gal./sq. yd..



1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

### 3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
- D. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.02 to 0.05 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.
1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
  2. Protect primed substrate from damage until ready to receive paving.
- E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.02 to 0.05 gal./sq. yd.
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### 3.5 PLACING HOT-MIX ASPHALT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
  2. Place hot-mix asphalt surface course in single lift.
  3. Spread mix at a minimum temperature of 250 deg F.
  4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
  5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
  - 1. Clean contact surfaces and apply tack coat to joints.
  - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
  - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
  - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

### 3.7 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
  - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct lay down and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
  - 1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.8 ASPHALT CURBS

- A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F.
  - 1. Asphalt Mix: Same as pavement surface-course mix.

- B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

### 3.9 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  - 1. Base Course: Plus or minus 1/4 inch.
  - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: 1/4 inch.
  - 2. Surface Course: 1/8 inch.
  - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

### 3.10 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
  - 1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

### 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979
  - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
  - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
    - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.

- b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

### 3.12 WASTE HANDLING

- A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION

## 321313 CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Concrete sidewalks, patios, driveways, stair steps, integral curbs, and exterior pads.

#### 1.2 RELATED SECTIONS

- A. Section 017123 – Site Field Engineering
- B. Section 017419 – Construction Waste Management and Disposal
- C. Section 310516 - Aggregates for Earthwork
- D. Section 312000 - Earth Moving
- E. Section 129300 – Site Improvements
- F. Section 312000 – Earth Moving

#### 1.3 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings
- B. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
- C. ACI 305R-91, Recommended Practice for Hot Weather Concreting
- D. ACI 306R-88, Recommended Practice for Cold Weather Concreting
- E. ACI 311.IR-92, ACI Manual of Concrete Inspection
- F. ACI 347R-94, Guide to formwork for concrete
- G. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement
- H. ASTM A497 - Welded Deformed Steel Wire Fabric for Concrete Reinforcement
- I. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement
- J. ASTM C33 - Concrete Aggregates
- K. ASTM C94 - Ready Mix Concrete
- L. ASTM C150 - Portland Cement
- M. ASTM C260 - Air-Entraining Admixtures for Concrete
- N. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete
- O. ASTM C494 - Chemical Admixtures for Concrete
- P. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
- Q. ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- R. The State of New Hampshire Department of Transportation “Standard Specifications for Road and Bridge Construction,” latest version (designated NHDOT).

#### 1.4 SUBMITTALS FOR REVIEW

- A. Product Data: Submit fabricator's specifications, data, and instructions for manufactured materials and products.
  - 1. Concrete mix designs including appropriate backup test data, certifications and laboratory test reports as required. See PART 2 of this Section for mix design requirements.
  - 2. Form Release Agent.
  - 3. Formwork material.
  - 4. Form Ties.
  - 5. Reinforcement.
  - 6. Expansion Joint Material and Backer Rod.
  - 7. Sealant.
  - 8. Admixtures.
- B. Shop Drawings: The Contractor shall provide shop drawings showing details of the Work, in particular.
  - 1. Shop drawings for all reinforcement.
  - 2. Layout, alignment and finishes.
  - 3. Anchorages or connections.

#### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).
- B. Perform Work in accordance with ACI 301 standards and recommended practices.
- C. Acquire cement and aggregate from same source for all work.
- D. Conform to ACI 305R when concreting during hot weather.
- E. Conform to ACI 306R when concreting during cold weather.
- F. Inspection, Testing and Quality Control: A testing agency will be selected and paid for by the Owner, for the services listed in Chapter 16 - Testing of ACI 301 Sections 16.3 and 16.4. Services required by the Landscape Architect and listed in Section 16.5 shall be paid by the Contractor.
  - 1. In general, the requirements throughout this Section are written with the purpose of securing the best workmanship and end results.
  - 2. The testing agency will aid the Contractor in the perfection of techniques for ensuring the best quality of the final product.
- G. Submit the following for record
  - 1. Concrete cylinder compression test results.

#### 1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

#### PART 2 - PRODUCTS

## 2.1 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, Type I – Normal: Do not change source of manufacturer of cement during the course of the work.
- B. Fine and Coarse Aggregates: ASTM C33.
- C. Water: Clean and not detrimental to concrete.

## 2.2 ADMIXTURES

- A. Do not use accelerating cement setting admixtures, (e.g. calcium chloride). Do not use membrane curing compound or any other admixture on any concrete against which additional concrete or other material is to be bonded. Use of any admixture must be approved in writing by the Landscape Architect prior to its use.
- B. Air Entrainment: ASTM C260.
- C. Chemical:
  - a. Water Reducing: ASTM C494 Type A, and containing not more than 0.1% chloride ions.
  - b. High range water reducing admixture: ASTM C494, Type F or G, and containing not more than 0.1% chloride ions.

## 2.3 ACCESSORIES

- A. Bonding Agent: No-solvent two component epoxy as manufactured by SIKA or equivalent.
- B. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days; manufactured by Five Star Products, Inc. or equivalent.
- C. Epoxy Injection System: Two-component injectable adhesive HIT HY150 as manufactured by HILTI or approved equivalent.
- D. Concrete Cleaning/Etching Solution shall be a commercial concrete cleaner containing solvents, chloride acids and stain removers. Solution shall be Sure-Klean Heavy Duty Concrete Cleaner, by ProSoCo, Kansas City, MO, or equivalent.

## 2.4 JOINT DEVICES AND FILLER MATERIALS

- A. Expansion Joint Filler: ASTM D3575; closed cell foam with the removal top strips, 1/2 inch thick.
- B. Expansion Joint Sealant: ASTM C1589, Type S, Grade P, Class 25, self-leveling elastomeric joint sealant rated for use in traffic areas, gray.
- C. Expansion Joint Devices: ASTM A1078, 18-inch, #6 epoxy-coated steel dowels.

## 2.5 FORM MATERIALS

- A. Wood or Steel form material, profiled to suit conditions.

## 2.6 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615; Grade 60; deformed billet steel bars.
- B. Welded Steel Wire Fabric: Plain type, ASTM A185; in flat sheets.

- C. Dowels: ASTM A615; 40 ksi yield grade, plain steel.

## 2.7 CONCRETE MIX

- A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.
- B. The mix design shall meet the requirements of ACI 318–89, Chapter 5. Include the water–cement ratio, air content, slump, admixtures, and the plant to be used.
- C. Use accelerating admixtures in cold weather only when approved by Architect/Engineer. Use of admixtures will not relax cold weather placement requirements.
- D. Use calcium chloride shall not be permitted.
- E. Use set retarding admixtures during hot weather only when approved by Architect/Engineer
- F. Add air entraining agent to normal weight concrete mix for work exposed to exterior.
- G. Provide concrete to the following criteria:
  - 1. Compressive Strength at 28 days = 4000 psi unless otherwise noted on plans
  - 2. Slump: 2–4 inches before addition of water reducer, 6–8 inches after the addition of water reducer.
  - 3. Maximum water: cement ratio = 0.60
  - 4. 5% - 7% Air entrainment
- H. Seal with penetrating concrete sealant.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify site conditions prior to placement of concrete. If conditions are not in conformance with these specifications, do not proceed with concrete placement until unsatisfactory conditions are corrected.
- B. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.
- D. Where concrete is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations. Examine areas where waterproofing system is turned up or flashed against vertical surfaces and horizontal waterproofing. Proceed with installation only after protection is in place.

### 3.2 SUBBASE

- A. Prepare subbase in accordance with State of New Hampshire Department of Transportation “Standard Specifications for Road and Bridge Construction,” latest version (designated NHDOT).

### 3.3 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Notify Architect/Engineer minimum 24 hours prior to commencement of concreting operations.



### 3.4 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

### 3.5 CONSTRUCTION OF FORMS- WORK EXPOSED TO VIEW

- A. The design and engineering of formwork, as well as its construction shall be the responsibility of the Contractor. Comply with applicable requirements of Chapter 4 and Chapter 13 of ACI 301.
- B. Maintain forms unusually tight and braced to prevent movement, misalignment and bleeding that will result in sand streaks, honeycomb, large fins, stains, or other unsightly appearance. In particular, make following provisions
  - 1. Arrange structural backing of formwork to coincide with joints between panels
  - 2. Provide edges of form panels in contact with concrete flush within 1/32", and forms for plane surfaces shall be such that the concrete will be plane within 1/16" in 4'. Seal all edges of plywood sheets to prevent absorption of water into edges. Water seepage at exposed edges is not acceptable; quality shoring and sealant must keep joints tight.
  - 3. Provide positive means of adjustment (steel adjustable shores and struts). Securely brace against lateral deflections.
  - 4. Coat forms in contact with concrete with specified form release agent applied according to the manufacturer's instructions by roller, brush or spray, to produce a uniform thin film without bubbles or streaks. Apply release agent in two coats for first use of the form and in one coat for each additional use.
  - 5. Any re-used forms shall be in sound condition with square edges and corners and have no surface blemishes or discontinuities that will cause imperfections on finished concrete surfaces. Do not reuse water damaged edge formwork.
  - 6. Metal form accessories that are to remain embedded shall terminate a minimum of 2" from surface of the concrete.
  - 8. Formwork design shall be based on full liquid head placing.
  - 9. Continuously observe formwork while concrete is being placed to see that there are no deviations from desired elevation, alignment, plumbness. If, during construction, any weakness develops and the falsework shows any undue settlement or distortion, stop work, remove affected construction if permanently damaged, and strengthen falsework.

### 3.6 REINFORCEMENT

- A. Place reinforcement as indicated on plans.
- B. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
- C. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

- D. Concrete over Waterproofing: Exercise care in placing concrete over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with concrete.

### 3.7 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301, ACI 318, and ACI 304.
- B. Notify Architect/Engineer minimum 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.
- D. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.
- E. Separate pads/slabs on grade from vertical surfaces with 1/2 inch thick joint filler.
- F. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface.
- G. Install joint devices in accordance with manufacturer's instructions.
- H. Install construction joint devices in coordination with paving pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- I. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- J. Place concrete continuously between predetermined expansion, control, and construction joints.
- K. Do not interrupt successive placement; do not permit cold joints to occur.
- L. Place paving in pattern indicated.
- M. If joints are saw cut, perform within 24 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness in joint layout per the hardscape plans.

### 3.8 JOINTS

- A. Place dowelled expansion joints as indicated on drawings (typically at 20 feet maximum). Align curb, gutter, and sidewalk joints.
- B. Place joint filler between paving components and building or other appurtenances. Recess top of filler 1/4 inch. Caulk joints with color matched silicone exterior caulking.
- C. Provide caw saw control joints at intervals indicated on drawings for new concrete areas.
- D. Provide trowel control joints as indicated on drawings in typical sidewalk replacement panels.

### 3.9 FINISHING

- A. Sidewalk Paving: Medium broom and trowel edges.
- B. Curbs and Gutters: Smooth trowel.
- C. Stair Treds: broom finish set perpendicular to traffic flow. Ease all edges.

- D. Inclined Vehicular Ramps: Broomed perpendicular to slope.
- E. Concrete pavement bases: Roughen surface slightly.
- F. Apply curing compound and sealer on exposed concrete surfaces in accordance with manufacturer's instructions.

### 3.10 JOINT SEALING

- A. Separate pavement from vertical surfaces with 1/2 inch thick joint filler.
- B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- C. Extend joint filler from bottom of pavement to within 1/4 inch of finished surface.

### 3.11 TOLERANCES

- A. Section 01400 - Quality Assurance: Tolerances.
- B. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- C. Maximum Variation from True Position: 1/4 inch.

### 3.12 FIELD QUALITY CONTROL

- A. Provide free access to Work and cooperate with Testing Agency.
- B. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- C. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.
- D. Four concrete test cylinders will be taken for every 50 cu yds of concrete placed. One cylinder shall be tested at 7 days, two at 28 days, and one at 56 days if necessary. Contractor shall provide a curing box on site and shall cooperate in the taking of test cylinders. Cylinders shall not be disturbed after casting.
- E. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.
- F. Slump, concrete temperature, and air content shall be tested for every truckload of concrete delivered. Concrete from any truck shall not be placed until these results have been reported to the concrete foreman and are determined to be in conformance with these specifications.

### 3.13 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- A. Protect expose to view concrete that may be subjected to abuse during the remainder of construction of the work. Protect such surfaces with 1/2" thick high-density fiberboard sheets or other suitable material approved by Landscape Architect. Sheets or material used for protection must not come into contact with concrete surface. Sheets or material shall be framed off concrete surfaces by using tie holes as support.

- C. Do not permit traffic over pavement until 75 percent design strength of concrete has been achieved.

END OF SECTION

**321640 GRANITE CURBING**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Material and application of granite curbing.
- B. Quality control.
- C. Submittals.

1.2 REFERENCES

- A. The State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).

1.3 QUALITY ASSURANCE

- A. Individual curb stones shall be furnished in minimum lengths between four and ten feet.
- B. Top surface of the curb shall be sawn to an approximately true plane and shall have not projection or depression greater than 1/8 inch.

1.4 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).

1.5 SUBMITTALS FOR REVIEW

- A. Submit name of quarry which is the proposed source.
- B. Dimensional shop drawing for each stone shape to be used.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Hard, durable quarried granite.
- B. Gray in color, free from seams, cracks or other structural defects.
- C. Bottom of the curb shall be parallel to the top and sawed or dressed to lay with not more than one inch between joints.
- D. Curbing stones to be set on a radius of 80 feet or less shall be cut to the curve required, and their ends shall be cut on radial lines.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavation shall be made to the required depth and the base material upon which the curb is to be set shall be compacted to a firm, even surface.

3.2 INSTALLATION

- A. Curb shall be set so that the front top arris line is in close conformity to the line and grade required.
- B. All space under the curbing shall be filled and thoroughly tamped with material meeting the requirements for the bed course.

3.3 JOINTS

- A. Curb shall be laid and fitted so there will be no opening between joints exceeding 1 inch.
- B. Joints between stones shall be carefully filled with Type 1 Mortar and neatly pointed on the top and exposed front portions.

3.4 BACKFILLING

- A. After the joints have set, any remaining excavated area shall be filled and tamped with approved material placed in layers not exceeding 6 inches in depth.

3.5 CLEANING

- A. Remove drips, overspray, improper markings, and paint material tracked by traffic by sand blasting, wire brushing, or other method approved by Engineer prior to performance.

END OF SECTION

## 321723 PAVEMENT MARKINGS

### PART 1 - GENERAL

#### 1.0 GENERAL REQUIREMENTS

- A. The conditions of the Contract and general requirements of the Project Manual apply to the General Contractor, Subcontractor, material suppliers, and all other persons furnishing labor and materials under this Section. GENERAL CONDITIONS, SUPPLEMENTARY CONDITIONS and applicable parts of DIVISION 1 are included as part of this Section.
- B. Examine all Project Specifications and Drawings for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.
- D. Refer to DIVISION 1 for Alternates which may affect the work of this section.
- E. When open-flame or spark producing tools such as blower torches, welding equipment, and the like are required in the process of executing the work, the General Contractor shall be notified not less than twenty four hours in advance of the time that the work is to begin and the location where work is to be performed. Provide fire protective covering and maintain constant non-working fire watch where work is being performed and until it is completed.

#### 1.1 SECTION INCLUDES

- A. Material and application of pavement and curb markings.
- B. Quality control.
- C. Submittals.

#### 1.2 REFERENCES

- A. The State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).

#### 1.3 QUALITY ASSURANCE

- A. All striping work will be subject to quality control testing as specified by the Owner.
- B. Paint handicap spaces to conform to ADA Standards and local code requirements

#### 1.4 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with State of New Hampshire Department of Transportation "Standard Specifications for Road and Bridge Construction," latest version (designated NHDOT).

#### 1.5 SUBMITTALS FOR REVIEW

- A. Submit description of paint to be used.
- B. Submit documentation of product acceptance by NHDOT.
- C. Submit manufacturers' installation requirements.

**PART 2 - PRODUCTS**

**2.1 MATERIAL**

- A. Pavement markings shall be made from a normal type reflectorized paint in standard colors per NHDOT specifications. All colors are to be approved by the Owner's representative.
- B. Colors
  - 1. White – parking stripes, crosswalk stripes, roadway lane stripes, and safety markings.
  - 2. Yellow – roadway center lines.
  - 3. Blue and white – accessible parking markings.

**PART 3 - EXECUTION**

**3.1 STRIPING**

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. Roadway surfaces shall be clean and dry at time of application.
- D. Lines shall be sharp and clear with no feathered edge or fogging.
- E. Surfaces shall be dry and free of grease and loose dirt particles. Scrape and wire brush chipped or damaged paint on existing curbs.
- F. Perform layout with chalk or lumber crayon only.

**3.2 APPLICATION**

- A. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
- B. Site Tolerances
  - 1. Make lines parallel, evenly spaced, and with sharply defined edges.
  - 2. Line Width-
    - a. Plus or minus 1/4 inch variance on straight segments.
    - b. Plus or minus 1/2 inch variance on curved alignments.
    - c. Maximum variation of film thickness is 1 mil.
- C. Provide two coat applications, each coat with coverage of 150 square feet per gallon.
- D. Do not apply materials when surface and ambient temperatures are outside ranges required by paint product manufacturer.
- E. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- F. Volatile organic content (VOC). Do not exceed State or Environmental Protection Agency maximum VOC on traffic paint.
- G. Painting shall be conducted according to standard practices per NHDOT. Restore the pavement



markings to the pre-construction configuration and/or as designated on the Design Drawings.  
Apply in accordance with manufacturer's instructions.

**3.3 CLEANING**

- A. Remove drips, overspray, improper markings, and paint material tracked by traffic by sand blasting, wire brushing, or other method approved by Engineer prior to performance.

END OF SECTION

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## 329300 KUA TREES PLANTS GROUND COVERS

### 1. SUMMARY

**Seeding, preparation, and mulching of lawn areas including drip stone and landscape edging shall be included in the base bid for the project.**

**The architect and Owner or Owner's representative shall be advised by the Construction Manager at least six weeks (i.e. To allow 2 weeks to identify a plant list and layout, and 4 weeks for selecting and locating plantings.) in advance as to the timing for selecting and locating plantings, in the case that they choose to review and add this into the project at that time. The Architect and Owner will respond within two weeks of being notified by the Construction Manager. Any cost associated with delays in providing this information to the Construction Manager will be borne by the Owner.**

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This section guides the preparation and installation of ~~trees, plants, ground covers, and edging~~ associated with pathways and drip strips.

The BIDDING REQUIREMENTS, CONTRACT FORMS, AND CONDITIONS OF THE CONTRACT and applicable parts of DIVISION 1 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made part of this Section.

Work Included: Provide all labor, materials and equipment necessary to complete the planting work, as indicated on the Drawings and as specified.

Related Sections:

Examine Contract Documents for requirements that affect work of this Section. Specifically see all civil engineering drawings. Also see Section 320100- Tree and Plant Protection

REFERENCES:

Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

- i. American National Standards Institute, Inc. (ANSI):  
Z60.1 American Standard for Nursery Stock (Sponsor: American Association of Nurserymen, Inc.)
- ii. American Society for Testing and Materials (ASTM):  
C136 Sieve Analysis of Fine and Coarse Aggregates  
E11 Wire Cloth Sieves for Testing Purposes
- iii. "Hortus Third", A Concise Dictionary of Plants Cultivated in the United States and Canada, Cornell University, L.H. Bailey Hortorium, MacMillan Publishing Co., New York, NY.

### 2. SUBMITTALS

The following are required as part of the submittal for these products:

**KUA Kilton/Welch Dormitories & Faculty Residences**

Vermont Integrated Architecture, P.C.

March 27, 2023 – Bid Package 1

Submittal	Req.	Specifics
Shop Drawings	X	- Final Layout for Trees, Shrubs, Perennials, and Ground Cover
Product Cut Sheets	X	- For all plants, including trees and shrubs. - For all fertilizers. - For all edging and accessories. - For all staking, watering, etc. accessories to support plants. - Environmental Product Declarations (EPDs) - Health Product Declarations (HPDs)
Product Samples	X	- See below.
Mock-ups	NA	-
Closeout submittals	NA	- Warranty Information, O & M Information

A. General: Refer to section 011000 - SUMMARY AND GENERAL REQUIREMENTS for submittal and provision procedures.

B. Samples - The following samples shall be submitted:

<u>Material</u>	<u>Sample Size or Quantity</u>
Mulch	1 ft. <sup>3</sup>
Peat Moss	1 ft. <sup>3</sup>
Planting Soil	1 ft. <sup>3</sup>
Soil Separator	1 ft. <sup>3</sup>
Topsoil from off-site sources	1 ft. <sup>3</sup>
Tree Stake	36 in. length
Tree Wrap	36 in. length
Metal Edging	12 in. length
Entry Canopy Roof River Stone	1 ft. <sup>3</sup>

C. Manufacturer's Product Data: Manufacturer's product data shall be submitted for the following materials: Aluminum sulfate

- Anti-desiccant
- Fertilizer
- Fungicide
- Insecticide
- Peat Moss
- Soil Separator
- Tree Wrap

D. Certificates: Labels from the manufacturer's container certifying that the product meets the specified requirements shall be submitted for the following materials:

- Bone Meal
- Commercial Fertilizer
- Limestone

- E. Test Reports: Test reports from an approved testing agency indicating compliance with the specifications shall be submitted for topsoil, peat moss, planting soil mixture, and any other materials designated by the Architect or Owner's Representative.

3. PRODUCTS

A. PLANTS

- i. Except as otherwise specified, size and grade of plant materials shall conform to ANSI Z60.1. In no case shall ball size be less than 11 inches in diameter for each inch of caliper.
- ii. Plants shall have outstanding form; symmetrical, heavily branched with an even branch distribution, densely foliated and/or budded, and a strong, straight distinct leader where this is characteristic of species. Plants shall possess a normal balance between height and spread. The Architect or Owner's Representative will be the final arbiter of acceptability of plant form.
- iii. Plants shall be healthy and vigorous, free of disease, insect pests and their eggs and larvae.
- iv. Plants shall have a well-developed fibrous root system.
- v. Plants shall be free of physical damage such as scrapes, broken or split branches, scars, bark abrasions, sunscalds, fresh limb cuts, disfiguring knots, or other defects. These defects shall not interrupt more than 25% of the circumference of the plant cambium.
- vi. Plants shall meet the sizes indicated on the Plant List. Plants larger or smaller than specified may be used only if accepted by the Architect or Owner's Representative.
- vii. Where a size or caliper range is stated, at least 50% of the materials shall be closer in size to the top of the range stated.
- viii. Plants shall not be pruned before delivery.
- ix. All trees and shrubs shall be labeled. Labels shall be durable and legible, stating the correct plant name and size in weather-resistant ink or embossed process. Labels shall be securely attached to all plants prior to delivery to the site, being careful not to restrict growth.
- x. Plants indicated as "B&B" shall be balled and burlapped.
  - a. Unless otherwise permitted by the Architect or Owner's Representative, plants shall be nursery grown.
  - b. Plants shall be grown for at least two years under climatic conditions similar to those in the locality of the Project.
  - c. Nursery grown plants shall be freshly dug. No heeled in plants from cold storage will be accepted, unless otherwise permitted by the Architect or Owner's Representative.
- xi. Container grown plants shall be well rooted and established in the container in which they are growing. They shall have grown in the container for a sufficient length of time for the root system to hold the planting medium when taken from the container, but not long enough to become root bound. Container grown plants exceeding the sizes indicated in ANSI Z60.1 shall have containers that are not less than 75% of the ball sizes for comparable B&B plant material. Each container plant shall be inspected and root pruned as needed.

- xii. Bareroot stock, where specified or approved by Architect or Owner’s Representative, shall meet the standards of ANSI Z60.1 and shall conform to the following.
  - a. Root system: The root system of bareroot stock shall be sufficient to ensure plant growth.
  - b. Bareroot Trees: Bareroot trees shall have a heavy fibrous root system that has been developed by proper cultural treatment, transplanting and root pruning. The spread of the root system shall be 12 times greater than the trunk diameter plus an additional 6 inches.
  - c. Bareroot Shrubs: Bareroot shrubs shall have a well-developed fibrous root system, with a minimum spread conforming to the following:

Plant Height in Feet	Minimum Spread of Roots in Inches
1.5 to 2	10
2 to 3	11
3 to 4	14
4 to 5	16
5 to 6	18
6 to 8	20

**B. SCREENED LOAM**

- i. Screened loam shall be natural, fertile agricultural soil, capable of sustaining vigorous plant growth. Screened loam shall be of uniform condition throughout without admixture of subsoil, and shall be clean and reasonably free from clay, lumps, stones, roots 2 inches or more in diameter, or other similar substances. It shall also be free of weeds, weed seeds, and debris, toxic substances such as lead, or objects which might be a hindrance to planting operations. Screened loam shall not be delivered or used for planting while in a frozen or muddy condition.

**C. TOPSOIL**

- i. Topsoil shall be obtained from a previously established stockpile on the site, to the extent that suitable material is available. Additional topsoil required shall be obtained from off-site sources.
- ii. Topsoil shall be a natural, fertile, friable loam typical of cultivated topsoil of the locality, containing at least 2% decayed organic matter (humus). Topsoil shall be taken from a well- drained, arable site, free of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots, or other objectionable, extraneous, matter or debris. Topsoil shall not be excessively acid or alkaline nor contain toxic substances.
- iii. Topsoil, whether stripped from site or supplied form off-site, shall be a sandy loam as defined by the USDA Soil Conservation Service, Soil Classification System, and shall have the following mechanical analyses:

Textual Class Average %	% Total Weight
Sand (0.05-2.0mm dia. range)	45 to 75
Silt (0.002-0.05mm dia. range)	15 to 35
Clay (less than 0.002mm dia.)	5 to 25

- a. 95% of topsoil shall pass a 2.0 mm sieve.
- b. Topsoil shall be free of stones 1 inch in longest dimension, earth clods, plant parts, and debris.
- c. Organic matter content shall be 4% to 12% of total dry weight.

D. PEAT MOSS

- i. Peat moss shall be a horticultural grade, sphagnum peat moss containing partial decomposed fibrous or cellular stems and leaves of any of the many species of sphagnum mosses from fresh water sources conforming to the following requirements:
  - a. Peat moss shall be a homogeneous material free from decomposed colloidal residue lumps, roots, stones, and other foreign matter; and of such consistency that peat can pass a ½ inch mesh and can be readily incorporated with the topsoil.
  - b. The pH shall not be less than 3.5 nor greater than 6.0 at 25 degrees Celsius.
  - c. Organic matter content shall not be less than 90%, by weight, on an oven-dry basis.
  - d. Ash content shall not be more than 10%, by weight, on an oven-dry basis.
  - e. Moisture absorption capacity shall not be less than 800%, by weight, on an oven-dry basis.

E. PLANTING SOIL

- i. Planting soil shall be a mixture of 2/3 topsoil and 1/3 peat moss, by volume.
- ii. Planting soil shall have the following properties:
  - a. Naturally acidic, pH 6.0 to 6.5.
  - b. Manufactured soil-consistent ingredients with consistent results.
  - c. Biologically activated with natural soil organisms.
  - d. Rich in organic matter.
  - e. Well drained and highly absorbent.
- iii. Planting soil shall have the following composition:
  - a. 40% by weight: Medium pine bark mulch, medium aged bark with nominal size 1-1/2 in. and smaller.
  - b. 30% by weight: Topsoil Plus.
  - c. 30% by weight: Horticulture sand – a natural loamy sand.
- iv. Planting soil for non-ericaceous plants
  - a. Planting soil shall have pH value range of 5.0 to 7.0
  - b. If planting soil mixture does not fall within the required pH range, limestone or aluminum sulfate shall be added to bring the pH within the specified limit.
- v. Planting soil for ericaceous shrubs

- a. Planting soil for ericaceous shrubs shall be a mixture of 2 parts acid loam, 1 part peat moss, and 1 part coarse sand.
- b. Planting soil for ericaceous shrubs (e.g. –Rhododendrons, Azaleas) shall have a pH value range of 4.5 to 5.0.

F. PERLITE

- i. Perlite shall be super-coarse horticultural perlite, non-silicone treated, manufactured by Coralux perlite Corporation, Metuchen, NJ 08840, or approved equal.
- ii. Perlite shall be sterile, odorless, and nontoxic. Material shall weigh no more than 10 pcf, and shall retain at least 300% of its weight in water.

G. EXPANDED SHALE

- i. Expanded shale shall be lightweight aggregate equal to “Solite”, size 3/8 n.- 0, manufactured by Northeast Solite Corporation, Mount Marion, NY 12456.

H. LIMESTONE

- i. Lime shall be an approved agriculture limestone containing no less than 50% of total carbonates, and 25% total magnesium with a neutralizing value of at least 100%. The material shall be ground to such fineness that 40% will pass through a No. 100 U.S. Standard Sieve, and 98% will pass through a No. 20 U.S. Standard Sieve. The lime shall be uniform in composition, dry and free flowing, and shall be delivered to the site in the original unopened containers, each bearing the manufacturer’s guaranteed analysis. Any lime which becomes caked or otherwise damaged making it unsuitable for use will be rejected.
- ii. Ground limestone shall be an agricultural limestone containing a minimum of 85 total carbonates, by weight. Ground limestone shall be graded within the following limits:

Sieve Size	% Passing by Weight
No. 10	100
No. 20	90
No. 100	60

I. BONE MEAL

- i. Bone meal shall be readily available fine ground, steamed, packing house, bone, with a minimum analysis of 23% phosphoric acid and 1.0% nitrogen.

J. WATER

- i. Water shall be suitable for irrigation and shall be free from ingredients harmful to plant life.

K. ALUMINUM SULFATE

- i. Aluminum sulfate shall be unadulterated and shall be delivered in containers with the name of the material and manufacturer and net weight of contents.

L. COMMERCIAL FERTILIZER

- i. Fertilizer content shall conform to the following:

Constituent	% Present by Weight
Nitrogen (N)	5
Phosphorus (P)	10
Potassium (K)	10

- a. 50% of nitrogen shall be derived from natural organic source of ureaform.
- b. Available phosphorus shall be derived from superphosphate, bone meal or tankage.
- c. Potassium shall be derived from muriate of potash containing 60% potash.
- ii. Fertilizer shall be delivered in manufacturer’s standard container printed with manufacturer’s name, material weight and guaranteed analysis.
- iii. Fertilize with N-P-K analysis other than that stated above may be used provided that the application sat per square foot of nitrogen, phosphorus and potassium is equal to that specified.
- iv. Controlled- release fertilizer shall be equal to the following:

Product	Manufacturer
Agriform 20-10-5, Milpitas, CA 95035	Sierra Chemical Co. Planting Tablets
EZY- Grow Fertilizer	EZY- Grow- Landscape Packet Specialties

- v. Controlled-release fertilizer shall be Unique Fertilizer, Deptford, NJ 08096, right year duration, 4 oz. slow release 16-8-16 fertilizer packets, or approved equal.
- vi. Slow release fertilizer shall be Osmocote slow release 14-14-14 analysis.

M. ORGANIC FERTILIZER

- i. Organic Fertilizer: shall be a complete certified organic fertilizer equal to “Fertilaid Organic Activator”, manufactured by Microkey Sciences and distributed by The Organic Warehouse, or approved equal.
  - a. Fertilizer shall be delivered in manufacturer’s standard container printed with manufacturer’s name, material weight and guaranteed analysis.
- ii. Organic Foliar Spray: Foliar spray mixture shall conform to the following:
  - a. Agrispon at 0.25 oz. per gallon of water
  - b. Liquid Seaweed at 0.50 oz. per gallon of water
  - c. Neo Life Green Seap at 0.50 oz. per gallon of water
  - d. Fish Emulsion at 1.00 oz. per gallon of water



N. SUPERPHOSPHATE

- i. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes, and containing not less than 20% available phosphoric acid. The superphosphate shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. A superphosphate which becomes caked or otherwise damaged making it unsuitable for use will be rejected.

O. MULCH

- i. Mulch shall be double shredded pine bark, or pine spruce bark mix, of uniform size and free from rot, leaves, twigs, debris, stones or any material harmful to plant growth. Bark shall have been shredded and stockpiled no less than six months and no more than two years before use. No chunks 3 inch or more in size, and thicker than ¼ inch shall be left on site.

P. SAND

- i. Sand shall be a standard horticultural product, washed, sharp sand, clean and free from foreign matter and chemical contamination, suitable for incorporating into planting soil.

Q. GUYING AND STAKING MATERIALS

- i. Wood Stakes: Straight, sound, rough sawn lumber not less than 2 in. x 2 in., if square, or 2-1/2 in. diameter, if round. Stakes shall be stained green. Wire for staking shall be 12-gauge steel.
- ii. Pipe Stakes: 1-1/2 in. diameter Schedule 40 black steel pipe. Stakes shall receive a coating of flat black exterior enamel paint before installation.
- iii. Wires for Guying: Galvanized steel 1 x 19 performed 3/16 inch diameter. Thimbles and nicopress clips shall be used for connections and splices.
- iv. Turnbuckles: Galvanized steel with an 8 inch lengthwise opening fitted with eyebolts.
- v. Hose: High quality braided rubber hose, ¾ inch diameter and suitable length, black in color.

R. WRAPPING MATERIAL

- i. Tree wrapping cloth material shall be equal to the following:
  - a. Osburg Cloth, 4-7/8 in. wide, unbleached, pinked on both edges, manufactured by The Carnegie Textile Co., 1734 Ivanhoe Road, P.O. Box 10276, Cleveland, OH 44110.

S. ANTIDESICCANT

- i. Antidesiccant shall be an emulsion specifically manufactured for plant protection that provides a protective film over plant surfaces which is permeable enough to permit transpiration. Antidesiccant shall be delivered in manufacturer's sealed containers and shall contain manufacturer's printed instructions for use.
- ii. Antidesiccant shall be equal to the following:
  - a. Product manufacturer:  
Wilt-Pruf  
Wilt-Pruf Products, Inc.

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PO Box 469  
Essex, CT 06426

T. EDGING

- i. Landscape Brick Edging at STA-MAT (or approved equal) Pathway – Alternate.
  - a. Re-use existing bridge edging as possible.
  - b. Match Existing Landscape Brick Edging if new material is needed.
  - c. Set in semi-dry mix, when wetted then dries to solidify and stabilize.
- ii. Aluminum Edging at Drip Stone Areas
  - a. Shall be PermaLoc Aluminum Landscaping Edging or approved equal. Edging shall be shop fabricated, 3/16 in. thick x 5.5 in. deep. Mill finish. Edging shall be furnished in 16' ft. lengths minimum and be interlocking.
    1. Aluminum edging shall have slotted holes for staking at regular intervals per manufacturer's installation requirements.
    2. Steel stakes shall be 16 in. long, tapered.
    3. To be provided to contain drip stone.

U. DRIP EDGE STONE

Refer to Civil Drawings & Specifications

V. WASHED RIVER ROCK

- i. See architectural drawings for details, locations and size requirements
- ii. New England river stone, rounded and with a mix of various colors – 2" diameter minimum.
- iii. Clean stone to be provided to prevent washing of debris and fines at canopy fascia and drip edges, typ
- iv. Sample required. 1 ft.<sup>3</sup> minimum.
- v. Locations:
  - a. ~~Entry canopy roofs, as indicated on drawings~~ REMOVED FROM PROJECT SCOPE
  - b. Scupper and Downspout circular rain catchment feature (assume min depth as noted to cover drainage stone below. Top of stone to be 4-6" from top of concrete rim.)

W. EAST SCUPPER DOWNSPOUT RECEIVING STONE

- i. See architectural drawings for details
- ii. Sample required. 6" x 6" x 2" thick minimum.
- iii. Architect to choose from local, Vermont stone options (granite and marble is preferred).
- iv. Honed and shaped as noted in drawings.
- v. Stone shall be free of cracks and chips but may have character.

4. EXECUTION & QUALITY CONTROL

A. TESTING

Work shall be subject to inspection at all times by the Architect or Owner's Representative. The owner reserves the right to engage an independent testing laboratory in accordance with requirements of section 01410, TESTING LABORATORY SERVICE to analyze and test

materials used in the construction of the work. Where directed by the Architect or Owner’s Representative, the testing laboratory will make material analyses and will report to the Architect or Owner’s Representative whether materials conform to the requirements of this specification.

- i. Cost of test and materials analyses made by the testing laboratory will be borne by Owner when the indicate compliance with the Specification, and by the Construction Manager when they indicate non-compliance.
- ii. Testing equipment will be provided by and tests performed by gee sting laboratory. Upon the request by the Architect or Owner’s Representative, shall provide such auxiliary personal and service needed to accomplish the testing work.
- iii. Gradation of granular materials shall be determined in accordance with ASTM C136. Sieves for determining material gradation shall be as described in ASTM E11.

**B. CONSTRUCTION MANAGER’S INSPECTION AND TESTING**

- i. Testing analyses and inspection required by the Construction Manager for their own information guidance shall be at their own expense.
- ii. The Construction Manager shall engage an independent testing agency, experienced in the testing of agriculture and horticultural soils that is acceptable to the Architect or Owner’s Representative, to perform the following tests and analyses:

Material	Tests and Analysis Required
Topsoil	Mechanical analysis of soil indicating the percent passing by weight of the following sieve sizes: 1in., 1/2in., No. 4, No. 10, No. 100, and No. 200. Determination of pH, organic content, and nutrient content. Recommendations shall be made by the testing agency as to the type and quantity of soil additives required to bring nutrient content and pH to satisfactory levels for planting.
Peat Moss	Determination of moisture absorption capacity, organic matter content, and pH.

- a. Materials shall not be used in construction until test results have been reviewed by the Architect or Owner’s Representative.
- b. All cost associated with testing shall be at Construction Manager’s expense.

**C. SOURCE QUALITY CONTROL**

- i. Identification of plant names shall be as listed in "Hortus Third".
- ii. Selection of Plant Materials: Submit to the Architect or Owner’s Representative the names and location of nurseries proposed as sources of acceptable plant material. Inspect all nursery materials to determine that the materials meet the requirements of this Section. Proposed materials shall be flagged at the nurseries by the Construction Manager prior to viewing by the Architect or Owner’s Representative.

- a. Schedule with the Architect or Owner's Representative a time for viewing plant material at the nursery. Trips to nurseries shall be efficiently arranged to allow Architect or Owner's Representative to maximize his viewing time. A minimum of six weeks shall be allowed for this viewing prior to time that plants are to be dug.
- b. Architect or Owner's Representative may choose to attach his seal to each plant, or representative samples.
- c. Where requested by the Architect or Owner's Representative, photographs of plant material or representative samples of plants shall be submitted.
- d. Viewing and/or sealing of plant materials by the Architect or Owner's Representative at the nursery does not preclude the Architect or Owner's Representative's right to reject material at the site of planting.

D. UNAVAILABILITY OF PLANT MATERIALS

- i. Before changes or substitutions can be made due to unavailability of plant material, submit evidence that the Construction Manager has advertised for a one month period with trade suppliers, with no response, or has undertaken other methods of locating plant material acceptable to the Architect or Owner's Representative.
- ii. Architect or Owner's Representative shall make all necessary plant substitutions in consultation with Construction Manager based on available stock.

E. DELIVERY, STORAGE, AND HANDLING

- i. Digging Plant Material: Plants shall not be dug at the nursery or approved source until the Construction Manager is ready to transport them from their original locations to the site of the work or acceptable storage location.
- ii. Transportation of Plant Material: Plants transported to the project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the body of the vehicle to prevent injury to the plants. Closed vehicles shall be adequately ventilated to prevent overheating of the plants.
  - a. Plants shall be kept moist, fresh, and protected at all times. Such protection shall encompass the entire period during which the plants are in transit, being handled, or are in temporary storage.
  - b. The roots of bareroot stock shall be protected from drying out with wet straw or other suitable material while in transit.
  - c. Unless otherwise authorized by the Architect or Owner's Representative, notify the Architect or Owner's Representative at least five working days in advance of the anticipated delivery date of any plant material. A legible bill of lading, showing the quantities, kinds, and sizes of materials included for each shipment shall be furnished to the Architect or Owner's Representative.
- iii. Storage: Unless specific authorization is obtained from the Architect or Owner's Representative, plants shall not remain on the site of work longer than three days prior to being planted.
  - a. Plants that are not planted immediately shall be protected as follows:
    - 1. Earth balls shall be kept moist and their solidity carefully preserved.
    - 2. Plants shall not be allowed to dry out or freeze.

- b. Bareroot plants may remain on the site of the work only 24 hours before being planted or placed in storage. During this 24-hour period, prevent injury and desiccation of plants on-site.
  - 1. Roots of plants in storage shall first be puddled in a paste solution of prepared planting soil and then watered.
  - 2. Plants shall then be protected and kept moist by “heeling-in” the roots or by placing the plant in a cool moist storage building. The “heeling-in” procedure shall require the plants to be separated and the roots heeled in a suitable moist soil. If plants are stored in a building, the roots shall be covered with a suitable mulch.
- c. Both the duration and method of storage of plant materials shall be subject to the approval of the Architect or Owner’s Representative.
- iv. Handling of Plant Materials: Exercise care in handling plant materials to avoid damage or stress.

F. REJECTION OF MATERIALS

- i. Evidence of inadequate protection following digging, carelessness while in transit, or improper handling or storage, shall be cause for rejection.
- ii. Upon arrival at the temporary storage location or the site of the work, plants shall be inspected for proper shipping procedures. Should the roots be dried out, large branches be broken, balls of earth broken or loosened, areas of bark torn, the Architect or Owner’s Representative will reject the injured plant.
- iii. When a plant has been rejected, remove it from the area of the work and replace it with one of the required size and quality.

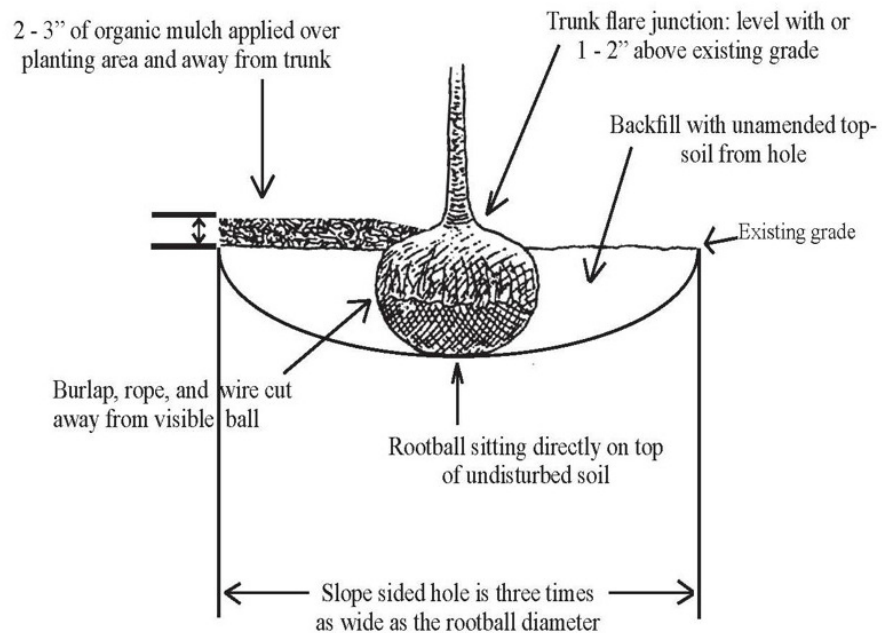
G. PLANTING SEASON

- i. Spring Planting: Spring planting may commence as soon as the ground has thawed at the nursery and at the site of planting, and weather conditions make it practicable to work both at the nursery and at the site.
  - a. Spring Planting shall not occur any later that the following:

Material	Planting Period
Deciduous Trees and Shrubs	May 15
Evergreen Trees and Shrubs	June 1

- ii. Fall Planting:
  - a. Fall planting for deciduous trees and any shrubs shall commence October 15 and continue until such time as the ground has frozen or weather conditions make it impractical to work.
  - b. Fall planting period for evergreen trees and shrubs shall be as follows: August 15 – October 15.
  - c. Potted plant material shall be planted between May 15 and October 15.
- iii. Regardless of the dates specified above, planting shall only be performed when weather and soil conditions are suitable for planting the material specified in accordance with locally accepted practice.

- iv. Planting season may be extended only with the written permission of the Architect or Owner's Representative.
  
- H. EXAMINATION OF SUBGRADE
  - i. Examine subgrade and rough grading before planting. Alert Architect or Owner's Representative to unacceptable rough grading or subgrade.
  
- I. DRAINAGE OF SOILS
  - i. Notify the Architect or Owner's Representative in writing of all soil or drainage conditions that he considers detrimental to growth of plant material. Submit proposal and cost estimate for correction of the conditions for Architect or Owner's Representative's approval before starting work.
  
- J. LAYOUT OF PLANTING AREAS
  - i. Individual plant locations and outlines of shrub and ground cover areas to be planted shall be staked by the Construction Manager in ample time to allow inspection by the Architect or Owner's Representative.
  - ii. Digging shall not begin until locations are approved by the Architect or Owner's Representative.
  - iii. Location of trees shall be staked using color coded stakes. A different stake color shall be used for each tree species.
  
- K. PREPARATION OF SUBGRADE
  - i. Subgrade of planting areas shall be loosened or scarified to a minimum depth of 3 inches prior to spreading planting soil. Subgrade shall be brought to true and uniform grade and shall be cleared of stones greater than 2 in., sticks and other extraneous material.
  
- L. PLANT PIT EXCAVATION
  - i. Planting pits for trees and shrubs shall be excavated to the depth and dimension appropriate for the type of tree and size per diagram following:



*Diagram illustrating proper planting procedure for a tree or shrub.*

- ii. Excavation shall not begin until locations have been approved by the Architect or Owner's Representative.
- M. EDGING
- i. Metal and/or brick edging shall be installed at locations indicated on the Drawings. Where required, edging shall be cut square and accurately to required length.
    - a. Edging shall be securely staked in required position.
    - b. Adjacent lengths of edging shall overlap 8 in.
    - c. Edging shall be set plumb and vertical at required line and grade. Straight sections shall not be wavy; curved sections shall be smooth and shall have no kinks or sharp bends.
- N. SPREADING OF PLANTING SOIL
- i. Planting soil shall be placed and spread to required depths.
  - ii. Surfaces shall be graded and smoothed, eliminating all sharp breaks by rounding, scraping off bumps and ridges, and filling in holes and cuts.
- O. PLANTING
- i. Walls of plant pits shall be dug so that they are vertical and scarified.
  - ii. Plants shall be set as indicated on Drawings. Plants shall have same relationship to finished grade as in the nursery.
  - iii. Plants shall be turned to the desired orientation when required by Architect or Owner's Representative.

- iv. Containerized plants shall be removed from container taking care not to damage roots. The side of the root ball shall be scarified to prevent root-bound condition and plant positioned in planting pit.
  - v. Planting shall be positioned in center of planting pit, set plumb, and rigidly braced in position until all planting soil has been tamped solidly around the ball.
  - vi. Pits shall be backfilled with planting soil. Soil shall be worked carefully into voids and pockets, tamping lightly every 6 inches.
    - a. When pit is two-thirds full, plants shall be watered thoroughly, and water left to soak in before proceeding.
    - b. At this time, ropes or strings on top of ball shall be cut and shall be pulled back. Burlap or cloth wrapping shall be left intact around ball except those portions of wrap that are exposed at the top of ball shall be turned under and buried. Non-biodegradable ball wrapping and support wire shall be totally removed from ball and planting pit.
    - c. Wire baskets shall be completely cut away from sides of root ball, and removed from pit. Bottom of basket may remain.
    - d. Remove nursery plant identification tags.
  - vii. Backfilling and tamping shall then be finished and a saucer formed around plant pits.
  - viii. Saucer shall be filled with water and water shall be left to soak in. Saucer shall then be filled with water again.
- P. FLOWERING PLANTS
- i. Prepare flowering plant planting bed by application of fertilizers and pH-altering amendments as needed.
- Q. APPLICATION OF FERTILIZER
- i. Fertilizer shall be applied when planting pits are backfilled two-thirds full. Fertilizer application shall be of the type, rate, and timing recommended by the testing agency for each plant type.
    - a. Slow-Release Fertilizer
      - 1. Fertilization schedule for trees and shrubs using slow release 4 oz. packet system shall be as follows:

Plant Type	Size	No. of packets
Trees	1-2 in.	2
	2-2.5 in. cal.	3
	2.5-3 in. cal.	4
	3-4 in. cal.	5
	4-5 in. cal.	6
	5-6 in. cal.	8
Shrubs	1 ft. hgt.	1



	2 ft. hgt.	2
	3 ft. hgt.	3

2. Fertilizer packets shall be placed 6 to 8 in. deep below top of planting soil around root balls of plants. Packets shall be spaced evenly depending on the number of packets required.

R. APPLICATION OF ORGANIC FERTILIZERS

- i. Organic Fertilizer: Planting beds shall be fertilized two times per year (March and October) with Organic Fertilizer at a minimum rate of 20 lbs. per 1000 sq. ft. Rate of application shall be varied depending on fertilizer type used, weather conditions, and overall soil conditions to produce a consistent growth and color to the plantings. After application of fertilizer, planting beds shall be thoroughly watered.
- ii. Organic Foliar Spray: Planting beds shall be fertilized two times per year (May and July) with Organic Foliar Spray at a minimum rate of 2 gallons per 1000 sq. ft.

S. WRAPPING

- i. Trunks of deciduous trees shall be spiral wrapped to a minimum height of the third branch or two-thirds the height of tree, whichever is higher. Wrap shall be applied from base up and securely tied.

T. STAKING AND GUYING

- i. Each tree shall be staked or guyed immediately following planting. Plants shall stand plumb after staking or guying.

U. MULCHING

- i. Mulch shall be applied as follows (entire area listed shall be mulched).

Plant Type	Mulch Area	Mulch Depth in.
Tree	Saucer	3
Shrub	Saucer or Bed	3
Ground Cover	Bed	2

V. PRUNING

- i. Each tree and shrub shall be pruned to preserve the natural character of the plant. Pruning shall be done after delivery of plants and after plants have been inspected and approved by the Architect or Owner’s Representative. Pruning procedures shall be reviewed with Architect or Owner’s Representative before proceeding.
- ii. Pruning shall be done with clean, sharp tool. Cuts shall be made flush, leaving no stubs. No tree paint shall be used.
- iii. Dead wood, suckers, and broken and badly bruised branches shall be removed.

W. ACCEPTANCE

- i. The Architect or Owner’s Representative will inspect all work for Substantial Completion upon written notice of completion. The request shall be received at least ten calendar days before the anticipated date of inspection.
  - ii. Acceptance of plant material by the Architect or Owner’s Representative will be for general conformance to specified size, character, and quality, and shall not diminish responsibility for full conformance to the Contract Documents.
  - iii. Upon completion and re-inspection of all repairs or renewals necessary in the judgement of the Architect or Owner’s Representative, the Architect or Owner’s Representative will recommend to the Owner that acceptance of the work of this Section be given.
  - iv. Acceptance in Part
    - a. The work may be accepted in parts when it is deemed to be in the Owner’s best interest to do so, and when permission is given to the Construction Manager in writing to complete the work in parts.
    - b. Acceptance and use of such areas by the Owner shall not waive any other provisions of this Contract.
- X. MAINTENANCE
- i. Maintain plant material until the completion of guarantee period and Final Acceptance of work.
  - ii. Maintenance shall consist of pruning, watering, cultivating, weeding, mulching, removal of dead material, repairing and replacing of tree stakes, tightening and repairing of guys, repairing and replacing of damaged tree wrap material, resetting plants to proper grades and upright position, and furnishing and applying such sprays as are necessary to keep plantings free of insects and disease, and in healthy growing condition.
  - iii. Planting areas shall be kept free of weeds, grass, and other undesired vegetative growth.
  - iv. Following Acceptance, maintenance of plant materials shall become the Owner’s responsibility. Provide instructions and service as follows:
    - a. Provide Owner with written recommended maintenance program at time of Substantial Completion.
    - b. Make as many periodic inspections as necessary during the guarantee period, at no additional cost to the Owner, to inspect the condition of all plant materials. Submit written report of each inspection to the Owner outlining corrective measures required to keep the guarantee valid.
- Y. GUARANTEE
- i. Plants shall be guaranteed for a period of two years after the date of Acceptance by the Owner.
    - a. When the work is accepted in parts, the guarantee periods shall extend from each of the partial acceptances to the terminal date of the last guarantee period. Thus, all guarantee periods terminate at one time.
  - ii. Plants shall be healthy, free of pests and disease, and in flourishing condition at the end of the guarantee period. Plants shall be free of dead and dying branches and branch tips, and shall bear foliage of normal density, size, and color.

- iii. Replace dead plants and all plants not in a vigorous thriving condition, as determined by the Architect or Owner's Representative, during and at the end of the Guarantee Period and without cost to the Owner, as soon as weather conditions permit and within the specified planting period.
    - a. Replacements shall closely match adjacent specimens of the same species. Replacements shall be subject to all requirements stated in this Specification.
    - b. Make all necessary repairs due to plant replacements. Such repairs shall be done at no extra cost to the Owner.
    - c. The Guarantee of all replacement plants shall extend for an additional one year period from the date of their acceptance after replacement. In the event that a replacement plant is not acceptable during or at the end of the said extended Guarantee Period, the Owner may elect one more replacement or credit for each item.
  - iv. At the end of the Guarantee Period, and no less than five days prior to Final Inspection, staking and guying materials, and tree wrap and ties shall be removed from the site.
- Z. FINAL INSPECTION AND FINAL ACCEPTANCE
- i. At the end of the Guarantee Period, the Architect or Owner's Representative will, upon written notice of end of Guarantee Period, inspect the work for Final Acceptance. Request shall be received at least ten calendar days before the anticipated date for Final Inspection.
  - ii. After any and all necessary corrective work has been completed the Architect or Owner's Representative will certify in writing the Final Acceptance of the planting.

END OF SECTION 329300 KUA TREES PLANTS GROUND COVERS

## **331000 WATER UTILITIES**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Pipe and fittings for site water line including domestic water line and fire water line.
- B. Valves, fire hydrants and domestic water hydrants, manholes and covers, thrust blocks.
- C. Trenching and backfill.
- D. Water distribution system testing and disinfection.

#### **1.2 REFERENCES**

- A. Refer to all current and relative ASTM and AWWA sections.

#### **1.3 SUBMITTALS FOR REVIEW**

- A. Submit (4) complete copies of all samples and shop drawings to the owner's representative for approval. All related items shall be submitted at the same time.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories, hydrants, manholes and covers.
- C. On all manufacturers' product cut sheets, specific items submitted for review shall be clearly indicated.
- D. Approval for shop drawings and samples must be received prior to purchasing equipment and products, and prior to starting work.
- E. In-place soil compaction tests and necessary supporting lab work.
- F. Gradation tests for bedding materials and subsurface materials.
- G. Concrete tests including compression tests, on-site slump, temperature, and air-entrainment
- H. Test results of bacteriological testing as required by the state health department.

#### **1.4 SUBMITTALS FOR INFORMATION**

- A. Manufacturer's Instructions: Indicate special procedures required to install products specified.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

#### **1.5 SUBMITTALS AT PROJECT CLOSEOUT**

- A. Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations on record drawings.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

#### **1.6 QUALITY ASSURANCE**

- A. Perform Work in accordance with appropriate New Hampshire Department of Environmental Services codes.

- B. Protect all products and materials, before, during, and after installation.
- C. Where applicable, follow the manufacturer's recommended procedures for unloading, storage and installation of all products and materials.
- D. All water installations require inspection by the City or an approved third-party prior to any backfilling.

#### 1.7 EXISTING UTILITIES

- A. Location of utility installations and underground structures are shown as approximate on contract documents.
- B. Prior to submitting a proposal, the contractor shall fully review all drawings related to the existing site conditions, and shall become fully familiar with the nature and extent of the work to be done, and the materials required to complete the work.
- C. All utilities shall be located by the contractor prior to beginning construction. Report all discrepancies between that shown on the drawings and that found in the field to the engineer.
- D. Existing utilities shall be protected and supported during construction.
- E. All water, gas, cable, telephone, electric, sewer and other utilities found to interfere with the proposed construction shall be relocated in a manner acceptable to the engineer.

### PART 2 - PRODUCTS

#### 2.1 WATER PIPE

- A. Ductile Iron Pipe: AWWA C151
  - 1. Fittings: Ductile iron, standard thickness, Class 52. (AWWA C110, C153, C105, ANSI A21.10)
  - 2. Fittings: Cast Iron, 250 psi pressure rating (ANSI A21.10)
  - 3. Joints: Mechanical, push-on, and flanged (AWWA C111, C115.)
  - 4. Gaskets
    - a. Mechanical and push-on joints, ANSI A21.11.
    - b. Flanged joints: 1/8" thick ring or full faced rubber, ANSI A21.15.
  - 5. Bolts/Nuts
    - a. Mechanical joint: ANSI A21.11.
    - b. Flanged joint: ANSI A21.15.
  - 6. Mechanical joint glands shall be "Mega-Lug" retainer glands.
  - 7. Linings and lining repair to AWWA/ANSI C104.
    - a. Interior - Cement lined, double thickness bituminous seal.
    - b. Exterior - Bituminous coating approximately 2 mils thick, ANSI A21.51, ANSI A21.15, and ANSI A21.10.
    - c. Flange machined face coating: ANSI A21.15.
- B. Copper Tubing: ASTM B88, Type K annealed:
  - 1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
  - 2. Joints: Compression connection or AWS A5.8, BCuP silver braze.

#### 2.2 VALVES

- A. Each valve shall have maker's name, pressure rating and year in which manufactured cast on the

body. Deliver and store valves in shipping containers with labeling in place.

B. Gate Valves - up to 3 inches

Lead free Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, extension box and valve key.

C. Gate Valves - 3 inches and over

AWWA C509-87, Iron body, bronze trim, non-rising stem with square nut, single cast iron resilient wedge with synthetic elastomer coating, fusion bonded epoxy coated inside and out, resilient seat, double-o ring seals, mechanical joint ends, control rod, extension box and valve key. All bolts shall be stainless steel.

1. Resilient seat gate valves by Kennedy "Ken-Seal II" or equal.
2. Iron body gate valves to meet AWWA C-515.
3. Stem construction: non-rising.
4. Stem seals: double o-ring.
5. Gate: cast iron resilient wedge with synthetic elastomer coating, and shall be epoxy coated (fusion bonded) inside and out.
6. Bonnet hardware shall be stainless steel.
7. Outlet connection: standard mechanical joint
8. Operation: open counterclockwise.

D. Swing Check Valves - from 2 inches to 24 inches

AWWA C508, iron body, bronze trim, [45] [22] degree swing disc, renewable disc and seat, flanged ends.

E. Butterfly Valves - from 2 inches to 24 inches

AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, [ten] [infinite] position lever handle.

F. Tapping Valves

1. Tapping valves to meet ANSI/AWWA C509-87, standard for resilient seated gate valves.
2. Valves shall have a minimum working pressure of 150 psi.
3. Valves shall open counterclockwise.
4. Inlet flanges shall be class 125, ANSI B16.1, or ANSI/AWWA C110/A21.10.
5. Outlet connection: standardized mechanical joint.
6. Stem seals: o ring.
7. Stem construction: non-rising.
8. Seating: parallel seat
9. End connections: mechanical on run, flanged on branch.
10. Buried tapping valves shall be provided with a 2-inch square wrench nut and cast-iron valve box. If depth from grade to top of valve operating nut is greater than 6'-0, a valve stem riser made of high strength steel shall be provided. Depth from valve stem riser nut to grade will be 4 to 6 feet.

G. Tapping Sleeves

1. AWWA C509, latest revision.
2. AWWA C207, Class D, maximum working pressure of 150 psi.
3. Sleeves: split sleeves of ductile iron.
4. Mechanical joint ends with end and gasket seals.
5. Provide a 3/4" NPT test plug or other provision for air testing the valve and sleeve at maximum working pressure.

6. Bolts and nuts, mechanical joints: high strength cast iron or high strength low alloy steel, ANSI/AWWA C111/A21.11-90.
7. Bolts and nuts, flanged joints: high strength, low carbon steel conforming to ANSI/AWWA C110/A21.10-87, appendix a.
8. Coat all nuts and bolts with a rust resistant lubricant.
9. All bolts and nuts used with pipe sleeves shall be brush coated heavily after final tightening with bitumastic cold-applied material to thoroughly cover all exposed surfaces of bolts and nuts.

### 2.3 VALVE BOXES

- A. All buried valves shall be installed with a valve box.
- B. Acceptable valve box manufacturers are Mueller, Clow or equal. Model shall be cast iron, Clow F-2452 sliding type, two piece, or equal, with 5 1/4 inch shaft, size 664-A (40-60 inch overall length). Cast iron lids shall be Clow F-2490 or equal, with the word "water" cast into the top of the cover, and arrow showing the direction of opening.

### 2.4 HYDRANT

- A. Hydrant: Hydrant shall be Mueller Super Centurion 250 Model A-423, no substitutes. AWWA C502, UL 246, dry barrel type; 5 1/4-inch diameter valve seat opening; to open counterclockwise; 6 inch mechanical joint inlet connection with accessories, gland bolts, and gaskets. The hydrant shall have a head loss of no more than 3.40 psi through the 4 1/2-inch pumper nozzle at 1,000 gpm. All buried mechanical joint bolts and nuts (T-head, etc.) shall be Cor-Ten or equal.
- B. Hydrants shall be non-draining. Hydrant drains, if equipped, shall be plugged.
- C. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length. The location of the hydrant valve and seat shall remain in, or at, the shoe.
- D. Hose and Streamer Connection: One (1) 4 1/2 inch NST pumper nozzle and two (2) 2 1/2 inch NST hose nozzles with National Standard thread, with NS#7 pentagon operating nut and nozzle caps, or match sizes with utility company.
- E. Finish: Primer and two coats of red enamel.
- F. Depth of Bury: Hydrant shall be installed to the manufacturer's instructions with nozzles 20" above finished grade.

### 2.5 RELATED ITEMS

- A. Corporations: Manufactured in accordance with AWWA C800, with Mueller threads at the inlet and a compression-type fitting at the outlet, both of the same size. All corporations shall have the ability to withstand 150 psi working pressure.
- B. Curbstops: Manufactured in accordance with AWWA C800, shall be a quarter-turn, plug-type valve with an "O" ring-type seal and shall open left and have a positive stop. Both inlet and outlet fittings shall be compression-type, and no curbstop shall have the ability to drain the service line. Curbstop shall be tested for tightness and have the ability to withstand 150 psi working pressure. The valve shall open 1/4 turn (90 degrees) with a check or stop.
- C. Curb boxes shall be Eclipse E100 Type A with stainless steel straight rod as manufactured by Bingham & Taylor, or approved equal.

## 2.6 MANHOLES AND COVERS

- A. Manhole sections: Reinforced precast 4000 psi concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923.
- B. Lid and frame: ASTM A48, Class 30B, 30" opening, cast iron construction, machined flat bearing surface, removable lid with H20 rating. Lid and frame shall be placed off-center over manhole steps. The word "water" shall be marked on the lid.
- C. Manhole steps: Polyethylene (PE) coated 1/2-inch diameter steel rungs. Steps shall be installed at 12 inches on center.
- D. All pipe penetrations shall be pre-cast, and shall be clear of all joints by a minimum of 6 inches of full wall thickness.

## 2.7 CONCRETE THRUST BLOCKS

- A. Refer to drawings for required thrust block size and placement
- B. Class B Concrete shall have:
  - 1. Minimum compressive strength of 3500 psi at 28 days.
  - 2. Air entrainment of 4% to 6% by volume.
  - 3. Water cement ratio of 0.49 lbs. water/cement.
  - 4. Slump of 2 to 4 inches.
- C. Place no concrete when ambient temperature is below 40 degrees Fahrenheit or more than 90 degrees Fahrenheit.
- D. No concrete shall be dropped more than six feet inside a form.
- E. Maintain temperature of concrete surface at minimum 50 degrees Fahrenheit for 72 hours after placing concrete. Preheat all enclosures for a minimum of 2 hours to provide a minimum surface temperature of 45 degrees Fahrenheit.
- F. Care shall be taken to ensure that concrete will not come in contact with flanges, joints or bolts.
- G. Allow all thrust blocks, concrete supports, and anchors to set and cure a minimum of 24 hours before backfilling.
- H. Completely cure and set concrete a minimum of 7 days before any hydrostatic or leakage testing of pipeline systems.

## 2.8 BEDDING, COVER, AND BACKFILL MATERIALS

- A. Pipe Bedding and Cover: Fill Type meeting the requirements of Sand (NHDOT Item 304.1).
- B. Trench Backfill: Natural materials excavated from the trench excluding debris, pieces of pavement, organic matter, top soil, wet or soft muck, peat or clay, excavated ledge material, rocks over 6 inches in the largest dimension; and shall be free of unsuitable materials as defined by NHDOT 203.2.7 and NHDES ENV-WQ 704.11(h); and free of any material not approved by the engineer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION



- A. Verify existing conditions.
- B. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.
- C. Notify local municipalities 48 hours prior to commencing any waterline work. Specify which services are likely to be interrupted and the estimated schedule of work.

### 3.2 TRENCHING AND BEDDING

- A. Preparation
  - 1. Identify required lines, levels, contours, and datum locations.
  - 2. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
  - 3. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
  - 4. Maintain and protect above and below grade utilities which are to remain.
  - 5. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Fill Type meeting the requirements of Crushed Gravel (NHDOT Item 304.3) and compact to density equal to or greater than requirements for subsequent backfill material.
- B. Excavating
  - 1. Excavate subsoil required for utilities to municipal utilities.
  - 2. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
  - 3. Do not interfere with 45 degree bearing splay of foundations.
  - 4. Excavation shall be 12 inches below pipe inverts to accommodate the bedding material. Correct areas over excavated. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
  - 5. Stockpile excavated material in area designated on site and remove excess material not being used, from site.
- C. Form and place concrete for pipe thrust restraints at any change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. See drawings for thrust restraint bearing dimensions and placement.
- D. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8 inches compacted depth; compact to 95 percent of standard optimum density.
- E. Backfill around sides and to 12 inches over top of pipe with cover material, tamp in place and compact to 95 percent of standard optimum density.
- F. Maintain optimum moisture content of bedding material to attain required compaction density.

### 3.3 INSTALLATION – PIPE

- A. Installation of all water lines shall be to City of Lebanon Construction Standards or as listed below, with more stringent condition governing.
- B. During loading, transportation, and unloading, take care to prevent damage to pipes and fittings. Examine all pipes and fittings before laying, no damaged piece shall be installed. Take care to keep inside of pipe clean.
- C. Maintain separation of water main from sewer and other piping in accordance with City of

Lebanon Construction Standards and “The Recommended Standards for Water Works” so called Ten State Standards.

- D. Install pipe to indicated elevation to within tolerance of 5/8 inches.
- E. Install ductile iron piping and fittings to AWWA C600.
- F. Install grooved and shouldered pipe joints to AWWA C606.
- G. Route pipe in straight line. Maximum permissible deflection is 75% of AWWA specification C600.
- H. Pipe shall be laid with bell ends facing in the direction of laying.
- I. Where pipe is laid on a slope of 5% or more, the laying shall start at the low end and proceed uphill, with the bell ends upgrade.
- J. A watertight plug shall be placed in the open ends of installed pipe when pipe laying is not in progress.
- K. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- L. Install access fittings to permit disinfection of water system.
- M. Slope water pipe and position drains at low points.
- N. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.
- O. Establish elevations of buried piping to ensure not less than 5 ft of cover in grassed areas, and 6 ft of cover in paved areas. If minimum cover is not attainable, install rigid insulation over pipe in width and thickness as shown on drawings.
- P. If any defective piping or fitting is discovered after it has been laid, it shall be removed and replaced at the contractor’s expense.

### 3.4 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Refer to applicable details for backfill material type and compaction requirements.
- D. Backfill material shall be compacted in 12-inch layers.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. At cross country locations Backfill shall be mounded 6 inches above original ground.
- G. Remove surplus fill materials from site.
- H. Leave fill material stockpile areas completely free of excess fill materials.

### 3.5 INSTALLATION - VALVES AND HYDRANTS

- A. Installation of all valves and hydrants shall be to City of Lebanon Construction Standards or as listed below, with more stringent condition governing.
- B. Set valves on solid bearing.

- C. Center and plumb valve box over valve. Set box cover flush with finished grade.
- D. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.
- E. Set hydrants to grade, with nozzles at least 20 inches above ground.

### 3.6 SERVICE CONNECTIONS

- A. Provide water service to utility company requirements with reduced pressure backflow preventer and water meter with by-pass valves and sand strainer.
- B. Provide sleeve in walls for service main. Support with reinforced concrete bridge. Calk enlarged sleeve watertight.
- C. Anchor service main to interior surface of wall.
- D. Provide 18 gage galvanized sheet metal sleeve surrounding service main to 6 inches above floor and 6 feet minimum below grade. Size for 2 inches minimum of glass fiber insulation stuffing.

### 3.7 HYDROSTATIC AND LEAKAGE TEST

- A. Perform a hydrostatic and leakage test according to Town of Enfield Construction Standards and AWWA C600 (latest revision) on each pipe line, with the more stringent conditions governing.
- B. The Engineer shall be given 24 hours notice before the test is conducted. Test must be witnessed by the Engineer.
- C. Each valved section, or a maximum of 1000' shall be tested. All hydrostatic and leakage tests shall be witnessed by City of Enfield DPW or an approved third party. Contractor shall supply all necessary labor, equipment, and water to perform the test. All water required for testing shall be potable. Specified test pressure is 1.5 times the static pressure or as required by NFPA 24, whichever is greater. The pressure during the 2 hour test shall not vary by more than 5 psi. Failure to hold the designated pressure for the two-hour period, or greater leakage resulting than that allowed, constitute a failure of the section tested. Contractor shall do everything necessary to locate and repair or replace the defective pipe, fittings, or joints at no expense to the owner.

### 3.8 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Flush and disinfect system in accordance with AWWA, Town of ~~Enfield~~ Hanover Construction Standards, NPFA 24, and AWWA C651 (latest version), with the more stringent conditions governing. The form of chlorine utilized, method of chlorine application, final flushing, bacteriological testing, and repetition of procedure shall be reported to the Engineer.
- B. The Engineer shall be given 72 hours notice before the disinfection is conducted. The disinfection must be witnessed by the Engineer.
- C. The contractor shall supply all necessary labor, equipment and materials to disinfect the pipe system. Flush all pipeline systems prior to disinfection. Disinfection shall be repeated as required at no expense to the Owner until final acceptance by the Owner. Only after samples of the water from the flushed, disinfected pipe system show no evidence of bacteriological contamination, shall the disinfection process be deemed acceptable. Copies of all results shall be furnished immediately upon receipt to the Engineer.

### 3.9 RESTORATION OF THE SURROUNDING SITE

**KUA Kilton/Welch Dormitories & Faculty Residences**

Vermont Integrated Architecture, P.C.

March 27, 2023 – Bid Package 1

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- A. At the completion of waterline installation, the surrounding site shall be restored according to drawings (if shown), otherwise to a condition equal to that existing before the beginning of the work.

END OF SECTION

**333000 SANITARY SEWERAGE UTILITIES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Gravity sanitary sewers and force mains including drainage piping, fittings, accessories, bedding, manholes, clean-outs and covers.
- B. Connection of building sanitary drainage system to municipal sewers.
- C. Trenching and backfill.

**1.2 REFERENCES**

- A. Refer to all current and relative ASTM sections.
- B. New Hampshire Department of Environmental Services Code of Administrative Rules Chapter Env-Wq 700.

**1.3 SUBMITTALS FOR REVIEW**

- A. Submit (4) complete copies of all samples and shop drawings to the owner's representative for approval. All related items shall be submitted at the same time.
- B. Product Data: Provide data on pipe materials, pipe fittings, and accessories, manholes, covers, and clean-outs.
- C. On all manufacturers' product cut sheets, specific items submitted for review shall be clearly indicated.
- D. Approval for shop drawings and samples must be received prior to purchasing equipment and products, and prior to starting work.
- E. In-place soil compaction tests and necessary supporting lab work.
- F. Gradation tests for bedding materials and subsurface materials.

**1.4 SUBMITTALS FOR INFORMATION**

- A. Manufacturer's Instructions: Indicate special procedures required to install Products specified.
- B. Certificates: Certify that products meet or exceed specified requirements.

**1.5 SUBMITTALS AT PROJECT CLOSEOUT**

- A. Record actual locations of piping mains, connections, thrust restraints, and invert elevations on record drawings.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

**1.6 REGULATORY REQUIREMENTS**

- A. Conform to all applicable rules and regulations set forth by New Hampshire Department of Environmental Services for materials and installation of the Work of this section.

**1.7 QUALITY ASSURANCE**

- A. Perform Work in accordance with appropriate utility company, municipality and state codes.
- B. Protect all products and materials, before, during, and after installation.
- C. Where applicable, follow the manufacturer's recommended procedures for unloading, storage and installation of all products and materials.

#### 1.8 EXISTING UTILITIES

- A. Location of utility installations and underground structures are shown as approximate on contract documents.
- B. Prior to submitting a proposal, the contractor shall fully review all drawings related to the existing site conditions and shall become fully familiar with the nature and extent of the work to be done and the materials required to complete the work.
- C. All utilities shall be located by the contractor prior to beginning construction. Report all discrepancies between that shown on the drawings and that found in the field to the engineer.
- D. Existing utilities shall be protected and supported during construction.
- E. All water, gas, cable, telephone, electric, sewer and other utilities found to interfere with the proposed construction shall be relocated in a manner acceptable to the engineer.

### PART 2 - PRODUCTS

#### 2.1 PIPE MATERIALS

- A. Ductile-Iron, Gravity Sewer Pipe and Fittings
  - 1. Pipe: ASTM A 746, for push-on joints, Class 52.
  - 2. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
  - 3. Compact Fittings: AWWA C153, ductile iron, for push-on joints.
  - 4. Gaskets: AWWA C111, rubber.
- B. Plastic Pipe – Standard Gravity (Unless otherwise noted on the plans/profiles):
  - 1. Pipe: ASTM D3034-04A, Polyvinyl chloride (PVC), solid wall, SDR 35
  - 2. Plastic sewer pipe shall have a pipe stiffness rating of at least 46 pounds per square inch at 5 percent pipe diameter deflection, as measured in accordance with ASTM D2412-02 during manufacture
  - 3. Joint seals for PVC pipe shall be oil resistant compression rings of elastomeric material conforming to ASTM D3212-96(a)(2003)e1 and shall be push-on, bell-and-spigot type.
  - 4. Fittings: ASTM D 3034, PVC with bell ends.
  - 5. Gaskets: ASTM F 477, elastomeric seals.
- C. Plastic Pipe – Pressure Rated (Where noted on plans/profiles for force mains and sewer-water crossings):
  - 1. Pipe: ASTM D 1784, Polyvinyl chloride (PVC), cell class 12454, meeting AWWA C900, Class 150 requirements of DR 18.
  - 2. Integral bell pipe provided with factory-installed gaskets meeting requirements of ASTM F 477.
  - 3. Gasketed joint assembly shall meet requirements of ASTM D 3139 and shall be push-on, bell-and-spigot type.

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4. Buried transitions between different sewage force main pipe materials shall be constructed with Romac Industries Macro HP (D.I.) or approved equal.

## 2.2 PIPE ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, clean-outs, reducers, traps and other configurations required. Field fabricated, saddle-type connections are not acceptable.

## 2.3 MANHOLES AND COVERS

- A. Manhole barrel, cone, and base sections: Reinforced precast 4000 psi concrete, minimum 48 inch diameter, in accordance with ASTM C478-06 Horizontal joints between sections of precast concrete barrels shall be of an overlapping type, sealed for water-tightness using a double row of an elastomeric or mastic-like sealant. All manholes shall be coated with a waterproof asphalt sealer.
- B. Lid and frame: ASTM A48/48M-03, Class 30, 30" opening, cast iron construction, machined flat bearing surface, removable lid with H20 rating. Lid and frame shall be placed off-center. The word "SEWER" shall be marked on the lid in 3-inch letters cast into the top surface.
- C. Manhole steps: Prohibited. If precast manhole sections or bases are delivered with precast holes for steps, the holes shall be filled with mortar or otherwise covered in a permanent watertight manner.
- D. All pipe penetrations shall be pre-cast and shall be clear of all joints by a minimum of 6 inches of full wall thickness.
- E. For pipe penetrations into existing manholes, contractor shall use Kor-N-Seal (or approved equal) elastomeric or watertight seal.
- F. Pipe to manhole joints shall be as follows:
1. Elastomeric, rubber sleeve with watertight joints at the manhole opening and pipe surfaces;
  2. Cast into the wall or secured with stainless steel clamps;
  3. Elastomeric sealing ring cast in the manhole opening with seal formed on the surface of the pipe by compression of the ring; and
  4. Non-shrink grouted joints where watertight bonding to the manhole and pipe can be obtained.
- G. Base sections shall be of monolithic construction to a point at least 6 inches above the crown of the incoming pipe.
- H. Manhole cone sections shall be eccentric in shape.
- I. All precast sections and bases shall have the date of manufacture and the name or trademark of the manufacturer impressed or indelibly marked on the inside wall.
- J. The castings shall be of even-grained cast iron, smooth, and free from scale, lumps, blisters, sand holes, and defects.
- K. Contact surfaces of covers and frames shall be machined at the foundry to prevent rocking of covers in any orientation.
- L. Brick masonry for shelf, invert and grade adjustment shall comply with ASTM C32-05, clay or shale, for grade SS hard brick.

- M. Mortar shall be composed of Portland cement and sand with or without hydrated lime addition.
- N. Proportions in mortar of parts by volumes shall be:
  - 1. 4.5 parts sand and 1.5 parts cement; or
  - 2. 4.5 parts sand, one part cement and 0.5 part hydrated lime.
- O. Cement shall be Type II Portland cement conforming to ASTM C150-05.
- P. Hydrated lime shall be Type S conforming to the ASTM C207-06 “Standard Specifications for Hydrated Lime for Masonry Purposes”.
- Q. Sand shall consist of inert natural sand conforming to the ASTM C33-03 “Standard Specifications for Concrete, Fine Aggregates”.
- R. When manhole depth is less than 6 feet, a reinforced concrete slab cover may be used in lieu of a cone section, provided the slab has an eccentric entrance opening and be capable of supporting H-20 loads.

#### 2.4 CLEAN-OUTS

- A. Pipe and Cover: Vertical pipe shall be PVC SDR 35. Clean-out frame and cover shall be Lebaron No. LA0910, or approved equal, and labeled “CLEANOUT”.

#### 2.5 BEDDING, COVER, AND BACKFILL MATERIALS

- A. Pipe Bedding: Fill Type meeting the requirements of ASTM C33-03 stone size No. 67.
- B. Pipe Cover: Fill Type meeting the requirements of NHDOT Item 304.1 (Sand).
- C. Trench Backfill: Natural materials excavated from the trench excluding debris, pieces of pavement, organic matter, top soil, wet or soft muck, peat or clay, excavated ledge material, rocks over 6 inches in the largest dimension; and shall be free of unsuitable materials as defined by NHDOT 203.2.7 and NHDES ENV-WQ 704.11(h); and free of any material not approved by the engineer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify existing conditions.
- B. Verify that building connection and municipal utility sewer main size, location, and invert are as indicated.
- C. Notify local municipalities 48 hours prior to commencing any sewer work. Specify which services are likely to be interrupted and the estimated schedule of work.

#### 3.2 TRENCHING AND BEDDING

- A. Preparation
  - 1. Identify required lines, levels, contours, and datum locations.
  - 2. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.



3. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
  4. Maintain and protect above and below grade utilities which are to remain.
  5. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Fill Type meeting the requirements of Crushed Gravel (NHDOT Item 304.3) and compact to density equal to or greater than requirements for subsequent backfill material.
- B. Excavating
1. Excavate subsoil required for utilities to municipal utilities.
  2. Cut trenches sufficiently wide to enable installation and allow inspection. The allowable trench width at a plane 12 inches above the pipe shall be no more than 36 inches. Remove water or materials that interfere with Work.
  3. Do not interfere with 45 degree bearing splay of foundations.
  4. Excavation shall be 12 inches below pipe inverts to accommodate the bedding material. Correct areas over excavated. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
  5. Stockpile excavated material in area designated on site and remove excess material not being used, from site.
- C. Pipe bedding material shall extend from a horizontal plane through the pipe axis to 12 inches below the bottom of the outside surface of the pipe.
- D. Pipe trench bedding material and fill material for excavation below grade shall be screened gravel or crushed stone to ASTM C33-03 stone size No. 67.
- E. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 12-inch compacted depth; compact to 95 percent of standard optimum density.
- F. The pipe sand blanket material shall be graded sand free from organic materials, graded such that 100 percent passes a ½-inch sieve and a maximum of 15 percent passes a #200 sieve.
- G. Pipe sand blanket material shall cover the pipe a minimum of 12 inches above the crown of the outside surface.
- H. Backfill around sides and to top of pipe with cover material, tamp in place and compact to 95 percent of modified optimum density.
- I. Maintain optimum moisture content of bedding material to attain required compaction density.
- J. Trench backfill at cross-country locations shall be natural materials excavated from the trench excluding debris, pieces of pavement, organic matter, top soil, wet or soft muck, peat or clay, excavated ledge material, rocks over 6 inches in the largest dimension, and any material not approved by the engineer, except that top soil, loam, muck or peat may be used provided the completed construction will be stable, and provided that access to the sewer for maintenance and reconstruction is preserved.

### 3.3 INSTALLATION – PIPE

- A. During loading, transportation, and unloading, take care to prevent damage to pipes and fittings. Examine all pipes and fittings before laying, no damaged piece shall be installed. Take care to keep inside of pipe clean.
- B. No connections of roof drains, area drains, foundation drains, cellar drains, or other clean water sources or any storm drains will be allowed to building or collection sewers.

- C. Coordinate the Work with termination of sanitary sewer connection outside building, connection to municipal sewer utility service, and trenching.
- D. Install pipe, fittings, and accessories in accordance with manufacturer's instructions.
- E. When a smaller sewer joins a larger one, the invert of the larger sewer shall be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.
- F. Lay pipe straight and to slope gradients noted on drawings; with maximum variation from true slope of 1:1000. Minimum slope for sewers shall be as follows:

Nominal Pipe Diameter (inches)	Minimum Slope (feet/foot)
8	0.0040
12	0.0022
15	0.0015
18	0.0012

- G. Pipe shall be laid with bell ends facing upgrade and laying shall start at the downgrade end.
- H. A watertight plug shall be placed in the open ends of installed pipe when pipe laying is not in progress.
- I. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- J. Sewers shall be buried to a minimum depth of 6 feet below grade in all roadway locations, and to a minimum depth of 4 feet below grade in all cross-country locations. If minimum cover is not attainable, install rigid insulation over pipe in width and thickness as shown on drawings.
- K. If any defective piping or fitting is discovered after it has been laid, it shall be removed and replaced at the contractor's expense.
- L. Sewers shall be located at least 10 feet horizontally from any existing or proposed water main.
- M. Whenever sewers must cross water mains, the sewer shall be constructed as follows:
  1. Vertical separation of the sewer and water main shall be not less than 18 inches, with water above sewer; and
  2. Sewer pipe joints shall be located at least 6 feet horizontally from the water main.

3.4 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Refer to applicable details for backfill material type and compact according to Section 312000.
- D. Backfill material shall be compacted in 12-inch layers.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. At cross country locations Backfill shall be mounded 6 inches above original ground.
- G. Remove surplus fill materials from site.
- H. Leave fill material stockpile areas completely free of excess fill materials.

### 3.5 INSTALLATION – MANHOLES

- A. Manhole shall be set at the correct elevation on a 12-inch layer of compacted bedding material that conforms to ASTM C33-03 No. 67 stone. The excavation shall be properly dewatered while placing bedding material and setting the base or pouring concrete. Water-stops shall be used at the horizontal joint of cast-in-place manholes.
- B. All pipes entering and leaving manhole shall be attached to pre-installed flexible rubber sleeves with stainless steel clamps.
- C. For sewers entering a manhole at an elevation of 24 inches or more above the manhole invert, a drop pipe shall be provided. Sewers shall not enter a manhole less than 24 inches and more than 6 inches above the manhole invert. Where the difference is less than 6 inches, the invert shall be filleted to prevent deposition of solids. In addition:
  - 1. The invert of the incoming pipe shall be no more than 6 inches above the invert of the outgoing pipe, unless a drop entry pipe is used;
  - 2. Sewer slopes shall be adjusted to avoid differences in incoming and outgoing pipe inverts greater than 6 inches, unless a drop entry pipe is used;
  - 3. A drop entry pipe shall be provided for any sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. The drop pipe may be constructed internal or external to the manhole;
  - 4. The maximum size limits and number of internal drop pipes within a manhole shall be as follows:
    - a. For 4-foot, 0-inch diameter manholes, one 10-inch diameter drop pipe; and
    - b. For 5-foot, 0-inch diameter manholes, one 15-inch or two 10-inch diameter drop pipes
  - 5. In the flow channel, a drop of at least 0.1 feet shall be provided between incoming and outgoing sewers on all manholes.
- D. Manholes shall have a brick paved shelf and invert constructed to conform to the size of pipe and flow. At changes in direction, the inverts shall be laid out in curves of the longest radius possible tangent to the center line of the sewer pipes. Shelves shall be constructed to the elevation of the highest pipe crown and sloped to drain toward the flowing through channel. Underlayment of invert and shelf shall consist of brick masonry. Inverts and shelves shall be placed after testing.
- E. In the flow channel, a drop of at least 0.1 feet shall be provided between incoming and outgoing sewers on all manholes.
- F. Slope across manholes shall be the average slope of the incoming and outgoing sewers.

### 3.6 TESTING

- A. If any tests referenced in this specification indicate that work does not meet the specified requirements, the contractor shall determine at his or her own expense, the source or sources of failure and shall repair if deemed possible by the Engineer or replace all defective materials or workmanship.
- B. Prior to any pipe testing for acceptance, the pipe shall be fully cleaned and visually inspected and shall be true to line and grade following installation and prior to use. The cleaning and visually inspection of the pipe shall be at the contractor's expense.
- C. Leakage Tests for Gravity Sewers

1. All new gravity sewers shall be tested for water tightness by the use of low-pressure air tests.
2. Low-pressure air testing shall be in conformance with:
  - a. New Hampshire Code of Administrative Rules (Env-Wq704.06).
  - b. ASTM F1417-92(2005) "Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air"; or
  - c. Uni-Bell PVC Pipe Association Uni-B-6, "Low-Pressure Air Testing of Installed Sewer Pipe" (1998).
3. The Engineer shall be given 24 hours notice before the test is conducted. Test must be witnessed by the Engineer.

**D. Leakage Tests for Manholes**

1. Manholes shall be tested for leakage using a vacuum test.
2. The manhole vacuum test shall conform to the following:
  - a. The initial vacuum gauge test pressure shall be 10 inches Hg; and
  - b. The minimum acceptable test hold time for a 1-inch Hg pressure drop to 9 inches Hg shall be 10 minutes.
3. The manhole shall be repaired and retested if the test hold times fail to achieve the acceptance limits specified in (2) above.
4. Following completion of the leakage test, the frame and cover shall be placed on the top of the manhole or some other means used to prevent accidental entry by unauthorized persons, children, or animals, until the contractor is ready to make final adjustment to grade.

**E. Pipe Deflection Test**

1. All new gravity sewers shall be:
  - a. Cleaned and visually inspected using a lamp test and by introducing water to determine that there is no standing water in the sewer; and
  - b. True to line and grade following installation and prior to use.
2. All plastic sewer pipe shall be visually inspected and deflection tested not less than 30 days nor more than 90 days following installation.
3. The maximum allowable deflection of flexible sewer pipe shall be 5% percent of average inside diameter. A rigid ball or mandrel with a diameter of at least 95% of the average inside pipe diameter shall be used for testing pipe deflection. The deflection test shall be conducted without mechanical pulling devices.
4. All pipe not meeting the deflection test shall be re-excavated and replaced at the Contractor's expense.

**3.7 RESTORATION OF THE SURROUNDING SITE**

- A. At the completion of sewer line installation, the surrounding site shall be restored according to drawings (if shown), otherwise to a condition equal to that existing before the beginning of the work.

END OF SECTION

## 334000 STORM DRAINAGE UTILITIES

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Site storm sewerage drainage piping, fittings and accessories, manholes, catch basins, covers, and bedding.
- B. Trenching and backfill.

#### 1.3 RELATED SECTIONS

- A. Section 31 00 00 – Earthwork

#### 1.4 REFERENCES

- A. Refer to all current and relative ASTM sections.
- B. New Hampshire Department of Environmental Services' Code of Administrative Rules Chapter Env-Wq 1500.
- C. New Hampshire Department of Environmental Services' *New Hampshire Stormwater Manual*, latest edition.

#### 1.5 SUBMITTALS FOR REVIEW

- A. Submit (4) complete copies of all samples and shop drawings to the owner's representative for approval. All related items shall be submitted at the same time.
- B. Product Data: Provide data on pipe materials, pipe fittings, and accessories, manholes, covers, and clean-outs.
- C. On all manufacturers' product cut sheets, specific items submitted for review shall be clearly indicated.
- D. Approval for shop drawings and samples must be received prior to purchasing equipment and products, and prior to starting work.
- E. In-place soil compaction tests and necessary supporting lab work.
- F. Gradation tests for bedding materials and subsurface materials.
- G. Concrete tests including compression tests, on-site slump, temperature, and air-entrainment

#### 1.6 SUBMITTALS FOR INFORMATION

- A. Manufacturer's Instructions: Indicate special procedures required to install Products specified.
- B. Certificates: Certify that products meet or exceed specified requirements.

#### 1.7 SUBMITTALS AT PROJECT CLOSEOUT

- A. Record actual locations of pipes, connections, and invert elevations on record drawings.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

- A. Perform Work in accordance with appropriate utility company, municipality and state codes.
- B. Protect all products and materials, before, during, and after installation.
- C. Where applicable, follow the manufacturer's recommended procedures for unloading, storage and installation of all products and materials.

1.9 EXISTING UTILITIES

- A. Location of utility installations and underground structures are shown as approximate on contract documents.
- B. Prior to submitting a proposal, the contractor shall fully review all drawings related to the existing site conditions, and shall become fully familiar with the nature and extent of the work to be done, and the materials required to complete the work.
- C. All utilities shall be located by the contractor prior to beginning construction. Report all discrepancies between that shown on the drawings and that found in the field to the engineer.
- D. Existing utilities shall be protected and supported during construction.
- E. All water, gas, cable, telephone, electric, sewer and other utilities found to interfere with the proposed construction shall be relocated in a manner acceptable to the engineer.

PART 2 - PRODUCTS

2.1 STORM PIPE MATERIALS

- A. Plastic Pipe: ASTM D3034, SDR 35, Poly Vinyl Chloride (PVC) material; bell and spigot style rubber ring sealed gasket joint, ASTM F758.
- B. Plastic Pipe: ASTM F2306, High-Density Polyethylene (HDPE), smooth interior and corrugated exterior, bell and spigot style rubber ring sealed gasket joint, ASTM F477.

2.2 ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, clean-outs, reducers, traps and other configurations required.
- B. Flared-End-Sections shall be a precast reinforced concrete pipe flared-end-section meeting ASTM C76 with a transition to pipe as shown on the drawings.

2.3 CATCH BASINS, MANHOLES AND COVERS

- A. Manhole and Catch Basin sections: Reinforced precast 4000 psi concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923.
- B. Lid and frame: ASTM A48, Class 30B, 24" opening, cast iron construction, machined flat bearing surface, removable lid with H20 rating. Lid and frame shall be placed off-center over manhole steps. Catch basin lids to be grated.

- C. Manhole steps: Not used. If precast manhole sections or bases are delivered with precast holes for steps, the holes shall be filled with mortar or otherwise covered in a permanent watertight manner.
- D. All pipe penetrations shall be pre-cast, and shall be clear of all joints by a minimum of 6" of full wall thickness.

#### 2.4 TRENCH DRAINS

- A. Traffic Areas: Prefabricated trench drain with heavy duty black steel frame and ADA compliant and heel proof ductile iron grate by Dura Trench, or approved equal.
- B. Pedestrian Areas: Prefabricated trench drain with heavy duty stainless steel frame and ADA compliant and heel proof stainless steel grate by Dura Trench, or approved equal.

#### 2.4 CLEAN-OUTS

- A. Pipe and Cover: Vertical pipe shall be PVC SDR 35. Clean-out frame and cover shall be Lebaron No. LA0910 or approved equal, and labeled "CLEANOUT".

#### 2.5 BEDDING, COVER, AND BACKFILL MATERIALS

- A. Pipe Bedding and Cover: Fill Type meeting the requirements of ASTM C33-03 stone size No. 67.
- B. Trench Backfill: Natural materials excavated from the trench excluding debris, pieces of pavement, organic matter, top soil, wet or soft muck, peat or clay, excavated ledge material, rocks over 6 inches in the largest dimension; and shall be free of unsuitable materials as defined by NHDOT 203.2.7 and NHDES ENV-WQ 704.11(h); and free of any material not approved by the engineer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify existing conditions.
- B. Verify that building connections and municipal utility storm sewer size, location, and invert are as indicated.
- C. Notify local municipalities 48 hours prior to commencing any storm sewer work. Specify which services are likely to be interrupted and the estimated schedule of work.

#### 3.2 TRENCHING AND BEDDING

- A. Preparation
  1. Identify required lines, levels, contours, and datum locations.
  2. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
  3. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
  4. Maintain and protect above and below grade utilities which are to remain.

- 
5. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Fill Type meeting the requirements of NHDOT Item 304.2 and compact to density equal to or greater than requirements for subsequent backfill material.
- B. Excavating
    1. Excavate subsoil required for utilities to municipal utilities.
    2. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
    3. Do not interfere with 45 degree bearing splay of foundations.
    4. Excavation shall be 6 inches below pipe inverts to accommodate the bedding material. Correct areas over Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
    5. Stockpile excavated material in area designated on site and remove excess material not being used, from site.
  - C. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8 inches compacted depth; compact to 95 percent of standard optimum density.
  - D. Backfill around sides and to 6 inches over top of pipe with cover material, tamp in place and compact to 95 percent of modified optimum density.
  - E. Maintain optimum moisture content of bedding material to attain required compaction density.
- 3.3 INSTALLATION – PIPE
- A. During loading, transportation and unloading, take care to prevent damage to pipes and fittings. Examine all pipes and fittings before laying, no damaged piece shall be installed. Take care to keep inside of pipe clean.
  - B. Coordinate the Work with termination of foundation and roof drain connections outside building, connection to municipal storm sewer utility service, and trenching.
  - C. Maintain separation from other piping in accordance with “The Recommended Standards for Water Works” so called Ten State Standards.
  - D. Install pipe, fittings, and accessories in accordance with manufacturer's instructions.
  - E. Lay pipe straight and to slope gradients noted on drawings; with maximum variation from true slope of 1:1000.
  - F. Pipe shall be laid with bell ends facing in the direction of laying.
  - G. Where pipe is laid on a slope of 5% or more, the laying shall start at the low end and proceed uphill, with the bell ends upgrade.
  - H. A watertight plug shall be placed in the open ends of installed pipe when pipe laying is not in progress.
  - I. Establish elevations of buried piping to ensure not less than 5ft of cover in grassed areas, and 6 ft of cover in paved areas. If minimum cover is not attainable, install rigid insulation over pipe in width and thickness as shown on drawings.
  - J. If any defective piping or fitting is discovered after it has been laid, it shall be removed and replaced at the contractor’s expense.



**3.4 BACKFILLING**

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Refer to applicable details for backfill material type and compaction requirements.
- D. Backfill material shall be compacted in 12-inch layers.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. At cross country locations Backfill shall be mounded 6 inches above original ground.
- G. Remove surplus fill materials from site.
- H. Leave fill material stockpile areas completely free of excess fill materials.

**3.5 INSTALLATION - MANHOLES, CATCH BASINS AND CLEAN-OUTS**

- A. Form bottom of excavation clean and smooth to correct elevation. Provide 12 inch crushed stone base.
- B. Form and place cast-in-place concrete base pad, with provision for storm sewer pipe end sections.
- C. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.
- D. Establish elevations and pipe inverts for inlets and outlets as indicated.
- E. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

**3.6 UTILITY MARKERS AND BURIED WARNING AND IDENTIFICATION TAPE**

- A. Provide and install metallic identification tape, tracer wire, and for all new utility lines or existing line where the contractor has disturbed the existing warning or metallic identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.
- B. Provide and install utility line monument markers, ball markers, (concrete with brass identification plugs) every 200 feet along straight runs and at each change of direction.

**3.7 RESTORATION OF THE SURROUNDING SITE**

- A. At the completion of storm sewer line installation, the surrounding site shall be restored according to drawings (if shown), otherwise to a condition equal to that existing before the beginning of the work.

END OF SECTION