



**Renovation to Campbell Library – Phase 1**

**PROJECT MANUAL**

**PROJECT NO. 77154**

**March 22, 2024**

**ROWAN UNIVERSITY**

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DIVISION 01 GENERAL REQUIREMENTS

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011000	Summary of Work
011400	Work Restrictions
021000	N/A
012200	N/A
012300	N/A
012400	Procedures and Controls
012500	Contract Modification Procedures
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013100	Coordination
013200	Construction Progress Schedule
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014000	Quality Control Requirements
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015000	Construction Facilities & Temporary Controls
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### TECHNICAL SPECIFICATIONS

<b>DIVISION 02</b>	<b>- EXISTING CONDITIONS</b>
024119	Selective Demolition
<b>DIVISION 03</b>	<b>- CONCRETE</b>
033053	Miscellaneous Cast-In-Place Concrete
035416	Hydraulic Cement Underlayment
<b>DIVISION 05</b>	<b>- METALS</b>
054300	Slotted Channel Framing
<b>DIVISION 06</b>	<b>- WOOD, PLASTICS, AND COMPOSITES</b>
061053	Miscellaneous Rough Carpentry
064116	Plastic-Laminate-Clad Architectural Cabinets
<b>DIVISION 07</b>	<b>- THERMAL AND MOISTURE PROTECTION</b>
075300	Thermoset EPDM Membrane Roofing
076200	Sheet Metal Flashing And Trim
077200	Roof Accessories
078413	Penetration Firestopping
078443	Joint Firestopping
079200	Joint Sealants
079219	Acoustical Joint Sealants
<b>DIVISION 08</b>	<b>- OPENINGS</b>
081213	Hollow Metal Frames
081216	Aluminum Frames
081416	Flush Wood Doors
083113	Access Doors And Frames
087100	Door Hardware
088000	Glazing
088700	Window Film
088813	Fire Rated Glass
<b>DIVISION 09</b>	<b>- FINISHES</b>
092216	Non-Structural Metal Framing
092900	Gypsum Board
093013	Ceramic Tiling
095113	Acoustical Panel Ceilings
096513	Resilient Base And Accessories
096519	Static Control Resilient Tile Flooring
096813	Tile Carpeting
096933	Cable Management Access Floor System
099133	Painting
<b>DIVISION 10</b>	<b>- SPECIALTIES</b>
101100	Visual Display Units
101419	Dimensional Letter Signage
101423	Panel Signage
102113.19	Plastic Toilet Compartments

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102213 Wire Mesh Partitions  
102800 Toilet, Bath, And Laundry Accessories  
104413 Fire Protection Cabinets  
104416 Fire Extinguishers

### **DIVISION 11 - EQUIPMENT**

Not Used

### **DIVISION 12 - FURNISHINGS**

122413 Roller Window Shades  
123623.13 Plastic Laminate Clad Countertops  
123661.16 Solid Surfacing Countertops

### **DIVISION 22 - PLUMBING**

22 05 00 Standard Conditions For Plumbing  
22 05 17 Sleeves And Sleeve Seals For Plumbing Piping  
22 05 18 Escutcheons For Plumbing Piping  
22 05 23.12 Ball Valves For Plumbing Piping  
22 05 23.14 Check Valves For Plumbing Piping  
22 05 29 Hangers And Supports For Plumbing Piping And Equipment  
22 05 53 Identification For Plumbing Piping And Equipment  
22 07 19 Plumbing Piping Insulation  
22 11 16 Domestic Water Piping  
22 11 19 Domestic Water Piping Specialties  
22 13 16 Sanitary Waste And Vent Piping  
22 13 19 Sanitary Waste Piping Specialties  
22 13 19 .13 Sanitary Drains  
22 40 00 Plumbing Fixtures

### **DIVISION 23 MECHANICAL**

23 01 30.52 Existing HVAC Air Distribution System Cleaning  
23 05 00 Standard Conditions for HVAC Work  
23 05 13 Common Motor Requirements for HVAC Equipment  
23 05 16 Expansion Fittings and Loops for HVAC Piping  
23 05 17 Sleeves And Sleeve Seals for HVAC Piping  
23 05 18 Escutcheons for HVAC Piping

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23 05 19	Meters And Gauges for HVAC Piping
23 05 23.11	Globe Valves for HVAC Piping
23 05 23.12	Ball Valves for HVAC Piping
23 05 23.13	Butterfly Valves for HVAC Piping
23 05 23.14	Check Valves for HVAC Piping
23 05 23.15	Gate Valves for HVAC Piping
23 05 29	Hangers And Supports HVAC Piping & Equip
23 05 48.13	Vibration Controls For HVAC
23 05 50	Fire Stopping
23 05 53	Identification For HVAC Piping and Equipment
23 05 93	Testing, Balancing, And Adjusting
23 07 13	Duct Insulation
23 07 19	HVAC Piping Insulation
23 09 23.11	Control Valves
23 09 33	Honeywell N4 – Java - Large Projects-Full Building
23 21 13	Hydronic Piping
23 21 16	Hydronic Piping Specialties
23 21 23	Hydronic Pumps
23 23 00	Refrigerant Piping System
23 31 13	Metal Ducts
23 31 21	Duct Cleaning
23 33 00	Air Duct Accessories
23 33 46	Flexible Ducts
23 34 16	Centrifugal HVAC Fans
23 34 23	HVAC Power Ventilations (Fans)
23 36 00	Air Terminal Units
23 37 13 .13	Air Diffusers
23 37 13. 23	Registers And Grilles

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23 81 26	Split System Air Conditioner (6-25 Tons)
23 81 27	Split System Heat Pump
23 81 28	Ductless Split System (Single Zone R410a)
23 82 16	Coils For Separate Duct Mount
23 82 30	Convectors, Extended Fin Radiation, Unit Heaters Convectors
23 83 33	Electric Heaters and Heat Tracing

### DIVISION 26 – ELECTRICAL

26 00 00	Standard Conditions for Electrical Work
26 01 26	Existing Equipment to Be Reused
26 05 00	Fire Stopping
26 09 00	Lighting Controls
26 27 00	Basic Materials and Equipment
26 28 16	Safety Switches - General Duty
26 28 17	Safety Switches - Heavy Duty
26 43 13	Surge Suppression
26 50 00	Led Lighting

### DIVISION 27 – COMMUNICATIONS

27 01 00	Operation and Maintenance of Communications Systems
27 05 00	Common Work Results for Communications
27 05 26	Grounding and Bonding for Communications Systems
27 05 28	Low Voltage Conduit Systems
27 05 29	Hangers and Supports for Communications Systems
27 05 53	Identification for Communication Systems
27 05 36	Cable Trays for Communications Systems
27 08 00	Commissioning Communications Systems
27 11 00	Communications Rooms Equipment Fittings
27 13 00	Communications Backbone Cabling
27 15 00	Communications Horizontal Cabling

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27 16 00      Communications Connecting Cords, Devices and Adapters

**DIVISION 28 - ELECTRONIC SAFETY AND SECURITY**

28 00 00      Common Work Results for Electronic Safety and Security  
28 01 00      Operation and Maintenance of Electronic Safety and Security  
28 05 26      Grounding and bonding for Electronic Safety and Security  
28 05 29      Hangers and Supports for Electronic Safety and Security  
28 05 53      Identification for Electronic Safety and Security  
28 13 00      Access Control  
28 23 00      Video Surveillance System  
28 30 00      Fire Alarm and Detection Systems – Address Horn

END OF SECTION

**ROWAN UNIVERSITY  
SECTION II  
INSTRUCTIONS TO BIDDERS**

**1B1. BID PROPOSALS**

- 1B1.1. Sealed proposals for the work described herein must be received and time-stamped at the University's Office of Contracting & Procurement. The closing date and time for bids will be stated in the Advertisement and Invitation for Bid. Bidders are cautioned that reliance on the U.S. Mail for timely delivery of proposals is at the bidder's risk. Failure by the contractor to have sealed proposals reach the University by the prescribed time will result in a return of the submission unopened and unread.
- 1B1.2. This contract will be bid as a single prime contract only. Bids for less than all of the project as described herein will be deemed nonconforming.
- 1B1.3. The Instructions to Bidders, Bid forms, Contract forms, plans and specifications, forms of Bid Bond, Agreement of Surety, Performance Bonds, Payment Bonds and other Contract Documents are published on the Procurement Website: <https://sites.rowan.edu/procurement/bids/index.html>. The University reserves the right to deny award to any bidder who is not deemed responsible based upon experience, past performance, and financial capability to perform the work required hereunder, or other material factors as outlined by N.J.S.A. 18A:64-9.
- 1B1.4. Set(s) of Contract Documents are published on the Procurement Website: <https://sites.rowan.edu/procurement/bids/index.html>
- 1B1.5. Bid proposals based upon the plans, specifications, general, special, and supplementary conditions, clarifications and/or addenda shall be deemed as having been made by the contractor with full knowledge of all project conditions. Bidders are strongly encouraged to visit the site prior to submitting proposals for the work herein described and to have thoroughly examined the conditions under which the contract is to be executed including those reasonably observable conditions of the premises which would hinder, delay or otherwise affect the performance of the contractor required under the terms of the contract. The University will not allow claims for additional costs as a result of the contractor's failure to become aware of the reasonably observable conditions affecting his/her required performance. The bidder is required to make appropriate allowances in the preparation of his/her bid for the accommodation of such conditions. Bidders must warrant in the bid documents that the bidder is familiar with conditions existing at the site at the time the bid is submitted.
- 1B1.6. Bid proposals shall be submitted on the standard form provided by the University, enclosed in a sealed envelope issued by Rowan University. The name and address of the bidder must be indicated on the envelope as well as indication of the project, project location and other appropriate identification.
- 1B1.7. All amounts in the bid documents shall be stated in numerical figures as well as written out in words. In the event of a contradiction between the numerical and written amounts, the written will control. Any illegible amounts will be deemed non-responsive.



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The bidder must include the following items in the bid envelope. Other documents may be required by the University Purchasing Department. Check the University's website for further information on required documents.

- a. Bidder's Checklist
- b. The Bid Form signed by the bidder
- c. Ownership Disclosure
- d. The executed Affidavit of Non-collusion;
- e. Bid security as further described in Paragraph 1B6;
- f. The Acknowledgement of Addenda;
- g. Consent of Surety
- h. The names and license numbers of and evidence of performance security form of all sub-contractors to who the bidder will sub-contract any of the work on the project for the following:
  - 1) The plumbing and gas fitting work;
  - 2) The heating and ventilating systems and equipment;
  - 3) The electrical work including any electrical power plants;
  - 4) The structural and ornamental iron work.
  - 5) Special Categories as may be required.

The remaining documents contained in the complete set of bid forms found after the Table of Contents shall be required prior to the award of the contract.

1B1.8. Proposals shall remain open for acceptance and may not be withdrawn for a period of sixty (60) days after the bid opening date.

1B1.9. Proposals not submitted and filed in accordance with instructions contained herein, and in the Advertisement, will be considered informal and rejected as non-responsive.

### 1B2. BID MODIFICATION

1B2.1. A bidder may modify his/her bid proposal by fax/email or letter at any time prior to the scheduled closing time for receipt of bids provided such communication is received by the University prior to such closing time. A written confirmation of any fax/email modification signed by the bidder must have been mailed and time-stamped by the post office prior to specified closing time. Such confirmation shall be accompanied by a newly executed Affidavit of Non-Collusion.

1B2.2. Faxed/emailed communications shall not reveal the basic bid price but only shall provide the amount to be added, subtracted or modified so that the final price(s) or term(s) will not be revealed until the sealed proposal is opened. If written confirmation of the telegraphic modification is not received within two (2) working days after the scheduled closing time, no consideration will be given to the telegraphic modification.

1B2.3. Bids may be withdrawn upon written request received from the bidder prior to the time fixed for the bid opening. Right for withdrawal of a bid is lost after a bid has been opened. If any error has been made in the bid amount, request for relief from the bid may be made in writing to the University. The written request shall be signed by an authorized corporate officer. A determination of whether the bidder will be released shall be at the sole discretion of the University who shall issue his/her finding(s) within five (5) days of his/her receipt of all pertinent information relating to such request for relief.

### 1B3. CONSIDERATION OF BIDS

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### 1B3.1. Award of Projects(s) or Rejection of Bid(s):

- a. The Project will be awarded to the lowest responsible bidder whose bid, conforming to the Contract Documents, will be most advantageous to the University. The award will be made or the bid(s) rejected within sixty (60) days from the date of the opening of the bids.
- b. All bid security deposits of unsuccessful bidders, except the lowest three (3) bidders, will be returned or refunded within five (5) days of the bid opening.
- c. The bid security deposits of the successful bidder and the next two (2) lowest bidders will be retained by the University until the execution and delivery of a formal contract and delivery of performance and payment bonds by the bidder awarded the project. At such time, bid deposits of the other two (2) low bidders will be returned.
- d. The University reserves the right to award the project on the basis of the single bid for the entire work on or the basis of a separate bid and alternate, or any combination of separate bids and alternates, which the University deems best serves the interest of the University.
- e. The University reserves the right to waive, in its sole discretion, minor informalities or non-material exceptions in the bid when such waiver is in the best interests of the University and where such waiver is permitted by law.
- f. The University reserves the right to reject any and all bids when such rejection is in the best interests of the University and is permitted by law. The University may also reject the bid of any bidder who, in its judgement, is not responsible or capable of performing the project based on financial capability, past performance or experience. A bidder whose bid is so rejected may request a hearing before the University by filing a written notice within seven (7) days of the transmittal of the rejection.

1B3.2. The bidder to whom the project is awarded shall execute and deliver the requisite Contract Documents including payment and performance bonds within the time specified. Upon his/her failure or refusal to comply in the manner and within the time specified, the University may either award the contract to the next low, responsible bidder or re-advertise for new proposals. In either case, the University may hold the defaulting bidder and his/her surety liable for the difference between the applicable sums quoted by the defaulting bidder and that sum which the University may be obligated to pay to the contractor who undertakes to perform and complete the work of the defaulting bidder.

### 1B4. AWARDS

1B4.1. In executing a contract, the successful bidder agrees to perform his/her work in a good and workmanlike manner and to complete portions of the work by established milestone dates and all work within the number of calendar days specified in his/her contract.

1B4.2. The successful bidder will be notified of the time and place for the signing of the contract. Key requirements in the conduct of the contract include, but are not limited to, project milestones, the number of days for performance of the contract, manner and schedule of payments, site logistics and other administrative details will be reviewed at the award meeting. The time and place of the first job meeting will also be announced.

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- 1B4.3. The project shall be awarded to the lowest responsible bidder whose bid, conforming to the Bidding Documents, will be the most advantageous to the University. Alternates will be accepted or rejected as selected by the University. Add alternates and deduct alternates will be specified separately. The University may choose from the add and deduct alternates without priority between the two groups. The University may accept alternates out of sequence provided it states its reasons for so doing.
- 1B4.4. Should submission of unit prices be required for specific items of work in bid proposals, they will be considered in the evaluation of bids.
- 1B4.5. LIQUIDATED DAMAGES ARE PART OF THIS PROJECT. Please refer to Section 017700 Contract Closeout in the Project Manual.
- 1B4.6. PLEASE NOTE THAT THE SUCCESSFUL BIDDER SHALL BE REQUIRED TO ENTER INTO **MODIFIED** AIA A101-2017 CONTRACT FOR CONSTRUCTION AND THE AIA A201-2017, BOTH OF WHICH ARE ATTACHED AS PART OF THIS BID PACKAGE.
- 1B5. QUALIFICATIONS OF BIDDERS
- 1B5.1. If the successful bidder is a corporation not organized under the laws of the State of New Jersey, or is not authorized to do business in this state, the award of the project shall be conditioned upon the prompt filing by the said corporation of a certificate to do business in this state and shall comply with the laws of this state in that regard. This filing must be made within the Division of Revenue and Enterprise Services. No award of project will be made until the Department of State confirms this authorization.
- 1B5.2. The University requires that each contractor shall perform a minimum of thirty-five percent (35%) of the contract work by his/her own forces. The University, however, may, in its sole discretion, reduce this percentage depending upon the nature and circumstances in any particular case if it determines that to do so would be in the best interests of the University provided that a written request is submitted to it prior to the bid opening.
- 1B5.3. The University reserves the right to reject a bid at any time prior to the signing of a contract if information or data is obtained which, in the opinion of the University, adversely affects the responsibility and/or the capability of the bidder to undertake and to complete the work regardless of the bidder's previous qualification or classification. The University may conduct any investigation as it deems necessary to determine the bidder's responsibility and capacity and the bidder shall furnish all information and data for this purpose as the University may request.
- 1B5.4. The bidder shall include a list of the sub-contractors to whom the bidder will sub-contract work with his/her bid for:
- a. the plumbing and gas fitting work;
  - b. the heating and ventilating systems and equipment;
  - c. the electrical work including any electrical power plants;
  - d. the structural and ornamental iron work; and
  - e. special categories as may be required.

Failure to provide this list shall result in rejection of the bid.

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### 1B6. DEPOSIT AND BID BOND

- 1B6.1. Each proposal shall be accompanied by a bid bond or by a certified or cashier's check made payable to the University equal to ten percent (10%) of the amount of the proposal as evidence of good faith which guarantees that, if the proposal submitted by the bidder is accepted, the bidder will enter into the contract and furnish the required Contract Documents and surety bonds. If a bid bond is submitted, it shall also provide that the surety issuing the bid bond be bound to issue the required payment and performance bonds if the bidder is awarded the project. If the bidder whose proposal is accepted is unable to provide the performance and payment bonds or fails to execute a contract, then such bidder and the bid bond surety shall be obligated to pay to the University the difference between the amount of the bid and the amount which the University contracts to pay another party to perform the work. The University reserves the right to retain any certified or cashier's check deposited hereunder as reimbursement for the difference as aforesaid and shall return any non-required balance to the bidder. Should there be a deficiency in the excess of the bid deposit, the bidder and the surety shall pay the entire amount of the University's difference in cost upon demand. Nothing contained herein shall be construed as reason of a default or breach by the contractor. Certified or cashier's checks or bonds submitted by the unsuccessful bidders will be returned after the contract has been executed. Contractors electing to furnish a bid bond must include consent of surety, both in form acceptable to the University.
- 1B6.2. Attorneys-in-fact who sign bid bonds or contract bonds must file a certified power of attorney with the University indicating the effective date of that power.

### 1B7. PERFORMANCE AND PAYMENT BONDS

- 1B7.1. Within five (5) calendar days, the successful bidder shall furnish a performance bond in statutory form (N.J.S.A. 2A:44-147) in an amount equal to one hundred percent (100%) of the total contract price as security for the faithful performance of this contract and also a payment bond in statutory form in an amount equal to one hundred percent (100%) of the contract price as security for the payment of all persons and firms performing labor and furnishing materials in connection with this contract. The performance and payment bond may be in one or in separate instruments in accordance with the law. No contract shall be executed unless and until each bond is submitted to and approved by the University and the surety must be presently authorized to do business in the State of New Jersey. The surety's obligation shall continue beyond final acceptance to the extent that the contractor would have such an obligation.
- 1B7.2. The cost of bonds shall be paid for by the contractor.
- 1B7.3. At any time, if the University is dissatisfied with any surety or sureties, who have issued or proposed to issue, the performance or payment bonds for justifiable cause, the contractor shall substitute an acceptable bond or bonds in such form and sum and executed by such other surety or sureties as may be satisfactory to the University within ten (10) days after notice from the University to do so. The premiums of such bonds shall be paid by the contractor. No contract shall be executed and/or no payment made under a contract until the new surety or sureties shall have furnished such an acceptance bond to the University.

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1B7.4. Bonds must be legally effective as of the date the contract is signed. Bonds must indicate contractor's names exactly as they appear on the contract. Current attorney-in-fact instruments and financial statement of the surety must be included with the bond. Bonds must be executed by an authorized officer of the surety. Bonds furnished under this article shall conform in all respects to the requirements and language of N.J.S.A. 2A:44-143 to 147.

### 1B8. ADDENDUMS AND INTERPRETATIONS

1B8.1. No interpretation of the meaning of the plans, specifications or other pre- bid documents will be provided to any bidder unless such interpretation is made in writing to all prospective bidders prior to the bid opening. Any such interpretations must be identified in bid proposals submitted. Any interpretations which are not entered in accordance with this provision shall be unauthorized and not binding upon the University.

1B8.2. Every request for an interpretation relating to clarification or correction of the plans, specifications or other bid documents shall be made in writing addressed to the University and must be received at least five (5) working days prior to the date fixed for the bid opening. Any and all interpretations, clarifications or corrections and any supplemental instructions must be issued by the University in writing in the form of addendums and will be published on the Procurement Website: <https://sites.rowan.edu/procurement/bids/index.html> . All addendums issued shall become part of the Contract Documents and shall be acknowledged in all the bid proposals. Failure of a contractor to acknowledge receipt of all such bulletins and interpretations by the time of the bid opening shall result in his/her proposal being considered non-responsive at the option of the University.

1B8.3. Each bidder shall be responsible for thoroughly reviewing the Contract Documents prior to submission of bids. Bidders are advised that no claim for expenses incurred or damage sustained on account of any error, discrepancy, omission or conflict in their bid submission will be entertained. Documents shall be recognized by the University unless, and only to the extent that, a written request for interpretation, clarification or correction has been submitted in compliance with section 1B8.2 and the matter has not been addressed by the University through the issuance of a bulletin interpreting, clarifying and/or correcting such error, discrepancy, omission or conflict.

### 1B9. ASSIGNMENTS

1B9.1. The contractor shall not assign the whole or any part of this contract without prior written consent of the University. Money due or to become due to the contractor hereunder shall not be assigned for any purposes whatsoever.

### 1B10. FEDERAL EXCISE TAXES AND STATE SALES TAX

1B10.1. In general, bidders must take into consideration applicable Federal and state tax laws when preparing their bids.

1B10.2. Under Chapter 32 of the Internal Revenue Code, an exemption certificate must be on file with the University of the Division of Purchasing. (example, Number 22-75-005)

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1B10.3. Materials, supplies or services for exclusive use in erecting structures or buildings or otherwise improving, altering or requiring all University-owned property are exempt from the State sales tax.

1B10.4. Bidders must make their own determinations as to the current status and applicability of any tax laws and the contractor may make no claim based upon any error or misunderstanding as to the applicability of any tax laws.

1B10.5. Purchases or rentals of equipment are not exempt from any tax under the State Sales Tax Act.

### 1B11. RESTRICTIVE SPECIFICATIONS

1B11.1. Should any bidder determine before the bid due date that any portion of the specifications or drawings specify a particular product which can be provided by one (1) supplier or manufacturer with the result that competitive prices are not available, he/she shall immediately notify the University and Construction Manager of the fact in writing.

1B11.2. If such notice is not given in a timely manner, it shall be assumed that the bidder has included the estimate of such sole source in his/her bid. In the alternative, if the University are notified in a timely manner of the requirement in the specification of a sole source of supply or manufacture, the University may order the project rebid or may take any other lawful action.

### 1B12. OFFER OF GRATUITIES

1B12.1. (a)Chapter 48 of the laws of 1954 make it a misdemeanor to offer, pay or give any fee, commission, compensation, gift or gratuity to any person employed by the State. It is the policy of the University to treat the offer of any gift or gratuity by any company, its officers or employees to any person employed by Rowan University as grounds for debarment or suspension of such company from bidding on and providing work or materials on University contracts. No vendor shall pay, offer to pay, or agree to pay, either directly or indirectly, any fee, commission, compensation, gift, gratuity, or other thing of value of any kind to any State officer or employee or special State officer or employee, as defined by N.J.S.A. 52:13D-13b. and e., in the Department of the Treasury or any other agency with which such vendor transacts or offers or proposes to transact business, or to any member of the immediate family, as defined by N.J.S.A. 52:13D-13i., of any such officer or employee, or any partnership, firm, or corporation with which they are employed or associated, or in which such officer or employee has an interest within the meaning of N.J.S.A. 52:13D-13g.

b. The solicitation of any fee, commission, compensation, gift, gratuity or other thing of value by any State officer or employee or special State officer or employee from any State vendor shall be reported in writing forthwith by the vendor to the Attorney General and the Executive Commission on Ethical Standards.

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- c. No vendor may, directly or indirectly, undertake any private business, commercial or entrepreneurial relationship with, whether or not pursuant to employment, contract or other agreement, express or implied, or sell any interest in such vendor to, any State officer or employee or special State officer or employee having any duties or responsibilities in connection with the purchase, acquisition or sale of any property or services by or to any State agency or any instrumentality thereof, or with any person, firm or entity with which he is employed or associated or in which he has an interest within the meaning of N.J.S.A. 52:13D-13g. Any relationships subject to this provision shall be reported in writing forthwith to the Executive Commission on Ethical Standards, which may grant a waiver of this restriction upon application of the State officer or employee or special State officer or employee upon a finding that the present or proposed relationship does not present the potential, actuality or appearance of a conflict of interest.
- d. No vendor shall influence, or attempt to influence or cause to be influenced, any State officer or employee or special State officer or employee in his official capacity in any manner which might tend to impair the objectivity or independence of judgment of said officer or employee.
- e. No vendor shall cause or influence, or attempt to cause or influence, any State officer or employee or special State officer or employee to use, or attempt to use, his official position to secure unwarranted privileges or advantages for the vendor or any other person.
- f. The provisions cited above in paragraph a. through e. shall not be construed to prohibit a State officer or employee or special State officer or employee from receiving gifts from or contracting with vendors under the same terms and conditions as are offered or made available to members of the general public subject to any guidelines the Executive Commission on Ethical Standards may promulgate under paragraph 3c.

### 1B.13 ANTIDISCRIMINATION

#### 1B.13.1 Pursuant to N.J.S.A. 10:2-1 The contractor agrees that:

- a. In the hiring of persons for the performance of work under this contract or any subcontract hereunder, or for the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under this contract, no contractor, nor any person acting on behalf of such contractor or subcontractor, shall, by reason of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex, discriminate against any person who is qualified and available to perform the work to which the employment relates;
- b. No contractor, subcontractor, nor any person on his behalf shall, in any manner, discriminate against or intimidate any employee engaged in the performance of work under this contract or any subcontract hereunder, or engaged in the procurement, manufacture, assembling or furnishing of any such materials, equipment, supplies or services to be acquired under such contract, on account of race, creed, color, national origin, ancestry, marital status, gender identity or expression, affectional or sexual orientation or sex;
- c. There may be deducted from the amount payable to the contractor by the contracting public agency, under this contract, a penalty of \$ 50.00 for each person for each calendar day during which such person is discriminated against or intimidated in violation of the provisions of the contract; and

**Renovations to Campbell Library – Phase 1**

Rowan University  
Rowan Project No. 77154

PROJECT MANUAL

Kimmel Bogrette Architecture  
KBAS Project No. 21-008

- d. This contract may be canceled or terminated by the contracting public agency, and all money due or to become due hereunder may be forfeited, for any violation of this section of the contract occurring after notice to the contractor from the contracting public agency of any prior violation of this section of the contract.

1.B.14 EQUAL PAY

1B.14.1. Pursuant to N.J.S.A. 34:11-56.14(b), any employer, regardless of the location of the employer, who enters into a contract with a public body to perform any public work for the public body shall provide to the Commissioner of the New Jersey Department of Labor and Workforce Development, through certified payroll records required pursuant to N.J.S.A. 34:11-56.25 et seq., information regarding the gender, race, job title, occupational category, and rate of total compensation of every employee of the employer employed in the State in connection with the contract. The employer shall provide the Commissioner, throughout the duration of the contract or contracts, with an update to the information whenever payroll records are required to be submitted pursuant to N.J.S.A. 34:11-56.25 et seq.

END OF SECTION I



# DRAFT AIA® Document A201™ - 2017

## General Conditions of the Contract for Construction

### for the following PROJECT:

(Name and location or address)

Renovations to Campbell Library – Phase 1

### THE OWNER:

(Name, legal status and address)

Rowan University  
201 Mullica Hill Road  
Glassboro, NJ 08028

### THE ARCHITECT:

(Name, legal status and address)

Kimmel Bogrette Architecture  
482 Norristown Road, Suite 200  
Blue Bell, PA 19422

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11	INSURANCE AND BONDS
12	UNCOVERING AND CORRECTION OF WORK
13	MISCELLANEOUS PROVISIONS

### ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

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## ARTICLE 1 GENERAL PROVISIONS

### § 1.1 Basic Definitions

#### § 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, the Contractor's Bid, University's Bid Solicitation, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. The Contract Documents shall include the Requirements as outlined specifically in the Bid Solicitation.

#### § 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a written Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§1.1.2.1 The Contractor acknowledges and warrants that it has closely examined all of the Contract Documents, that they are suitable and sufficient to enable the Contractor to complete the Work in a timely manner for the Contract Sum, and that they include all Work, whether or not shown or described, which reasonably may be inferred to be required or useful for the completion of the Work in full compliance with all applicable codes, laws, ordinances and regulations and that questions regarding the bid documents and any interpretation(s) regarding same have been asked by the contractor, in the form and manner required in the instructions to bidders.

#### § 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§1.1.3.2 Nothing in these General Conditions shall be interpreted as imposing on either the Owner or Architect/Engineer, or its respective agents, employees, officers, directors or consultants, any duty, obligation or authority with respect to any items that are not intended to be incorporated into the completed project, including but not limited to shoring, scaffolding, hoists, temporary weatherproofing, or any temporary facility or temporary activity, since these are the sole responsibility of the Contractor.

#### § 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

#### § 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

#### § 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

#### § 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

### § 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 Engineer/Architect. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

1.1.9 Contracting Officer means the individual authorized, as an officer of the University, to administer the design, engineering and construction of all University buildings and facilities. He/she is the procuring contracting officer representing the University personally or through University's project managers in all relationships with contractors, consultants and architects/engineers. This includes a duly appointed successor or an authorized administrative contracting officer (ACO) acting within the limits of his/her authority. The contracting officer is the interpreter of the conditions of the contract and the judge of its performance. He/she shall not take arbitrary positions benefiting either the University or the contractor but shall use his/her powers under the contract to enforce its faithful performance by both.

1.1.10 "Final Completion" shall mean the date the project, including all punch list items properly performed by the contractor, all warranties have been transferred to the University and the Contractor has demobilized from the site.

1.1.11 Substantial Completion: The date the building or facility is operational or capable of serving its intended use even though all permanent installations are not in place. The determination as to the date of substantial completion shall be made pursuant to Article 8.3 of the General Conditions and other applicable Sections in the Project Manual.

§ 1.1.12 The word "contractor" shall mean the prime contractor(s) with whom the contract has been executed.

### § 1.2 Correlation and Intent of the Contract Documents

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

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

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

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

### § 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

### § 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

### § 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-

**Commented [CEG1]:** Does Rowan typically hold ownership of the Instruments of Service?

subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

**§ 1.5.2** The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

**§ 1.6 Notice**

**§ 1.6.1** Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

**§ 1.6.2** Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

**§ 1.7 Digital Data Use and Transmission**

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

**§ 1.8 Building Information Models Use and Reliance**

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™-2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

**§ 1.9 EXECUTION OF CONTRACT DOCUMENTS**

**§ 1.9.1** The Contract Documents shall be signed by the Owner and Contractor. The Agreement shall be signed in not less than ~~quadruplicate~~ duplicate by the Owner and Contractor.

**§ 1.9.2** Execution of the Contract by the Contractor is a representation that said Contract Documents are full and complete, are sufficient to have enabled the Contractor to determine the cost of the Work therein to enter into the Contract and that the Contract Documents are sufficient to enable it to perform the Work outlined therein, and otherwise to fulfill all its obligations hereunder, including, but not limited to, Contractor's obligation to perform the Work for an amount not in excess of the Contract Sum on or before the date(s) of Substantial Completion established in the Agreement. The Contractor further acknowledges and declares that it has visited and examined the site, examined all physical, legal, and other conditions affecting the Work and is fully familiar with all of the conditions thereon and thereunder affecting the same. In connection with the foregoing, and having carefully examined all Contract Documents, as aforesaid, and having visited the site, the contractor acknowledges and declares that it has no knowledge of any discrepancies, omissions, ambiguities, or conflicts in said Contract Documents and that if it becomes aware of any such discrepancies, omissions, ambiguities, or conflicts, it will promptly notify Owner and Engineer of such fact.

**1.9.3.** The term "reasonably inferable" includes work necessary to provide work indicated or specified, as defined in section: Definitions and Standards; that is: furnish and install, complete, in place and ready for use.

1.9.3.1 Details referenced to portions of the Work shall apply to other like portions of the Work not otherwise detailed.

1.9.3.2 The Contractor shall request, from the Architect/Engineer interpretation of apparent discrepancies, conflicts, or omissions in the Specifications and Drawings. Subcontractors shall forward such requests through the Contractor. Such requests, and the Engineer's interpretation, shall be in written form; other forms of communications shall be used to expedite resolution of concerns, but will not be binding.

§1.9.4 Explanatory notes shall take precedence over conflicting drawn note indications. Large scale drawings shall take precedence over small scale drawings. Figured dimensions shall take precedence over scaled measurements. Should contradictions be found, the Engineer shall determine which indication is correct.

§1.9.5 Where it is required in the specifications that materials, products, processes, equipment, or the like be installed or applied in accordance with manufacturers' instructions, directions, or specifications, or words to this effect, it shall be construed to mean that said application or installation shall be in strict accordance with printed material concerned for use under conditions similar to those at the job site. Three copies of such instructions shall be furnished to the Engineer and his written approval thereof obtained before work is begun.

§1.9.6 Any material specified by reference to the number, symbol, or title of a Commercial Standard, Federal Specification, ASTM Specification, trade association standard, or other similar standards, shall comply with the requirements in the latest revision thereof and any amendments or supplements thereto in effect one month prior to the date on which bids are opened and read, except as limited to type, class, or grade, or modified in such reference. The standards referred to, except as modified in the specifications, shall have full force and effect as though printed in the specifications. The Engineer will furnish upon request information as to how copies of the standards referred to may be obtained.

## ARTICLE 2 OWNER

### § 2.1 General

§ 2.1.1 The Owner is Rowan University and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative. Contractor understands and acknowledges that the authority for all decisions required to be made resides with Owner. Contractor shall not rely upon or request from Architect/Engineer any decision which requires Owner's determination.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

### § 2.2 Evidence of the Owner's Financial Arrangements

~~§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.~~

~~§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may~~

immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start up, plus interest as provided in the Contract Documents.

**§ 2.2.3** After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

**§ 2.2.4** Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

### **§ 2.3 Information and Services Required of the Owner**

**§ 2.3.1** Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary permits, approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

**§ 2.3.2** The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number. Intentionally Omitted.

**§ 2.3.3** If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect. Intentionally Omitted.

**§ 2.3.24** If applicable, the Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The furnishing of these surveys and the legal description of the site shall not relieve the Contractor from its duties under the Contract Documents. Neither Owner nor the Architect/Engineer shall be required to furnish Contractor with any information concerning subsurface characteristics or conditions of the areas where the Work is to be performed. When the Owner or Architect/Engineer has made investigations of subsurface characteristics or conditions of the areas where the Work is to be performed, such investigations, if any, were made solely for the purposes of Owner's study. Neither such investigations nor the records thereof are a part of the Contract between Owner and Contractor. To the extent such investigations or the records thereof are made available to Contractor by the Owner or Architect/Engineer, such information is furnished solely for the convenience of Contractor. Neither Owner nor Architect/Engineer assumes any responsibility whatsoever in respect of the sufficiency or accuracy of the investigations thus made, the records thereof, or of the interpretations set forth therein or made by the Owner or Architect/Engineer in its use thereof, and there is no warranty or guaranty, either express or implied, that the conditions indicated by such investigations or records thereof are representative of those existing throughout the areas where the Work is to be performed, or any part thereof, or that unforeseen developments may not occur, or that materials other than or in proportions different from those indicated may not be encountered. The Contractor shall undertake such further investigations and studies as may be necessary or useful to determine subsurface characteristics and conditions. In connection with the foregoing, Contractor shall be solely responsible for locating (and shall locate prior to performing any Work) all utility lines, telephone company lines and cables, sewer lines, water pipes, gas lines, electrical lines, including, without limitation, all buried pipelines and buried telephone cables and shall perform the Work in such a manner so as to avoid damaging any such lines, cables, pipes, and pipelines. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

~~§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services. Intentionally Omitted.~~

~~§ 2.3.6~~ Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

#### **§ 2.4 Owner's Right to Stop the Work**

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, ~~or fails or refuses to provide a sufficient amount of properly supervised and coordinated labor, materials, or equipment so as to be able to complete the Work within the Contract Time or fails to remove and discharge (within ten~~th~~ree days) any lien filed upon Owner's property by anyone claiming by, through, or under Contractor, or disregards the instructions of Architect or Owner when based on the requirements of the Contract Documents,~~ the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, ~~except to the extent required by Section 6.1.3.~~

#### **§ 2.5 Owner's Right to Carry Out the Work**

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ~~ten~~three-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

### **ARTICLE 3 CONTRACTOR**

#### **§ 3.1 General**

**§ 3.1.1** The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

**§ 3.1.2** The Contractor shall perform the Work in accordance with the Contract Documents.

**§ 3.1.3** The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

#### **§ 3.2 Review of Contract Documents and Field Conditions by Contractor**

**§ 3.2.1** Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

**§ 3.2.2** Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. In addition to Contractor's duties under this Agreement, the Contractor shall carefully study and compare the Contract Documents with each other and shall at once report to the Owner errors, inconsistencies or omissions discovered. If the

Contractor performs any construction activity involving an error, inconsistency or omission in the Contract Documents that the Contractor recognized or reasonably should have recognized without such notice to the Owner, the Contractor shall assume complete responsibility for such performance and shall bear the full amount of the attributable costs for correction. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

3.2.2.1 In the event of a conflict between provisions of the contract documents, the documents shall take precedence in the following order:

- (a) Executed Contract
- (b) Addenda
- (c) Supplemental General Conditions
- (d) General Conditions
- (e) Specifications
- (f) Drawings in the following order of precedence:
  - (1) notes on drawings
  - (2) large scale details
  - (3) figured dimensions
  - (4) scaled dimensions

Where there may be a conflict not resolvable by application of the provisions of this paragraph, then the contractor shall accept the condition more favorable to the University. In the event the conflicting condition is one of physical materials, equipment and/or labor then the more expensive labor, materials or equipment shall be assumed to be required and shall be provided by the contractor.

3.2.3 On all work involving alterations, remodeling, repairs or installation within existing buildings, it shall be the responsibility of the contractor by personal inspection of the existing building, facility, plant or utility system to satisfy himself/herself as to the accuracy of any information given which may affect the quantity, size and/or quality of materials required for a satisfactorily completed contract whether or not such information is indicated on the drawings or is included in the specifications. All contracts shall include the cost of all material and labor required to complete the work.

3.2.4 Dimensions of the work shall not be determined by scale or rule and figured dimensions shall be followed at all times unless obvious discrepancies exist. The contractor shall verify all dimensions at the job site and shall take any and all measurements necessary to verify the drawings and to properly lay-out the work. Any discrepancies affecting the lay-out of the work shall be called to the Architect's/Engineer's attention. No work so affected shall proceed until such discrepancy is corrected and the Architect/Engineer provides written confirmation of the resolution to the University's project manager.

3.2.5 Where on any drawing a portion of the work is fully drawn and the remainder is indicated in outline form, the portions fully drawn shall apply to all other like portions of the work unless specifically indicated or specified otherwise.

3.2.6 All indications or notations which apply to one of a number of similar situations, materials or processes shall be deemed to apply to all such situations, materials or processes whether they appear in the work except where a contrary result is clearly indicated by the contract documents.

3.2.7 Where codes, standards, requirements and publications of public and private bodies are referred to in the specifications, references shall be understood to be to the latest revision prior to the date of receiving bids except where otherwise indicated.

3.2.8 Where no explicit quality or standards for materials or workmanship are established for work, such work is to be of good quality for the intended use.



3.2.9 All manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the manufacturer's written or printed directions and instructions unless otherwise indicated in the contract documents.

3.2.10 The mechanical, electrical and fire protection drawings are diagrammatic only and are not intended to show the alignment, physical locations or configurations of such work. Such work shall be coordinated by the Contractor and shall be installed to clear all obstructions, permit proper clearances for the work of other trades, satisfy all code requirements and present an orderly appearance where exposed at no additional cost to the Owner.

**§ 3.2.113** The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

**§ 3.2.124** If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities; unless the Contractor recognized such error, inconsistency, omission or difference and knowingly failed to report it to the Owner.

### **§ 3.3 Supervision and Construction Procedures**

**§ 3.3.1** The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

**§ 3.3.2** The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

**§ 3.3.3** The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.3.4 Contractor shall be solely responsible for the means and methods of the work performed. Owner shall have no obligation, responsibility and/or liability with respect to any issues, claims or controversies arising out of the manner in which work is performed, nor shall the Owner be responsible and/or liable for any issue, claim or controversy arising out of Contractor's failure to operate consistent with OSHA or other safety standards.

§ 3.3.5~~13.10~~ Regularly scheduled job meetings shall be held at a location and time convenient to the Owner's representatives, the Engineer and the Contractor. The Contractor shall attend such meetings, or be represented by a person in authority who can speak for and make decisions for the Contractor.

### § 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

### § 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

### § 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

### § 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the ~~Contractor-Owner~~ shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to the correction thereof or related thereto, including all fines and penalties~~correction.~~

### § 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from

those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

#### § 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- ~~.2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and~~
- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 ~~and (2) changes in Contractor's costs under Section 3.8.2.2.~~

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

#### § 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a full time competent superintendent, acceptable to the Owner, and necessary assistants who shall be in attendance at the Project site during performance of the Work and until final completion of all work, including all corrective and punch list items. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

#### § 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 ~~The~~ Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

**Commented [CEG2]:** We need to really emphasize the importance of this term with our own team.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

### § 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

### § 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

3.12.4.1 Unless otherwise stated in the Contract Documents, all submittals shall be provided electronically to the Contracting Officer.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect/Engineer and the Contracting Officer, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect/Engineer or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect/Engineer that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so; and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect/Engineer.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect/Engineer's

approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect/Engineer has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect/Engineer's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect/Engineer on previous submittals. In the absence of such notice, the Architect/Engineer's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect/Engineer will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect/Engineer. The Owner and the Architect/Engineer shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect/Engineer have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect/Engineer will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect/Engineer at the time and in the form specified by the Architect/Engineer.

### § 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.13.1 Location and weights of all equipment and materials and the Contractor intends to place on the site shall be submitted to the Owner for review.

§ 3.13.2 Only materials and equipment which are to be used directly in the Work shall be brought to and stored on the Project site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the Project site. Protection of construction materials and equipment stored at the Project site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.

§ 3.13.3 The Contractor and any entity for whom the Contractor is responsible shall not erect any sign on the Project site without the prior written consent of the Owner with the exception of those directed to be erected through the contract documents and those necessary for site safety or in an emergency.

§ 3.13.4 As required by the University's project manager, the contractor shall provide and maintain an eight foot (8') high temporary chain link fence with necessary posts and top rails to enclose the area at the job site and to guard and close effectively the designated area. The contractor shall be responsible for posting appropriate signage restricting

access and shall further be responsible for controlling access to the job site. All signage must follow University Design Standards and be approved by the project manager. The contractor shall provide gates at locations where required for access to the enclosed area. Gates shall be of chain link material, cross-braced, hung on heavy strap hinges and shall have suitable hasps and padlocks.

§ 3.13.5 The contractor shall remove the fence upon completion of the work or at such time before final completion as directed by the University.

§ 3.13.64 Contractor shall ensure that the Work, at all times, is performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. The Work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials and equipment likely to cause hazardous conditions. Without limitation of any provision of the Contract Documents, Contractor shall use its best efforts to minimize any interference with the occupancy or beneficial use of (1) any areas and buildings adjacent to the site of the Work.

§ 3.13.75 Without prior approval of the Owner, the Contractor shall not permit any workers to use any existing facilities at the Project site, including without limitation, lavatories, toilets, entrances and parking areas other than those designated by the Owner. Without limitation of any other provision of the Contract Documents, the Contractor shall use its best efforts to comply with all rules and regulations promulgated by the Owner in connection with the use and occupancy of the Project site and the Building, as amended from time to time.

§ 3.13.8 The Contractor shall immediately notify the Owner in writing if during the performance of the Work, the Contractor finds compliance with any portion of such rules and regulations to be impracticable, setting forth the problems of such and suggest alternatives through which the same results can be achieved. The Owner may, in the Owner's sole discretion, adopt such suggestions, develop new alternatives or require compliance with the existing requirement of the rules and regulations. The Contractor shall also comply with all insurance requirements and collective bargaining agreements applicable to use and occupancy of the Project site and the Building.

#### **§ 3.14 Cutting and Patching**

**§ 3.14.1** The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

**§ 3.14.2** The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

#### **§ 3.15 Cleaning Up**

**§ 3.15.1** The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

**§ 3.15.2** If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.15.3 Rowan University is a smoke free campus, and Contractor shall not allow its employees, agents, representatives, subcontractors, workers, etc., to smoke on the site or while on Rowan University property.

#### **§ 3.16 Access to Work**

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

### § 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

### § 3.18 Indemnification

#### § 3.18.1

§ 3.18.1 To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and their respective agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section 3.18.

.1 Contractor, for itself, its successors and assigns, agrees to indemnify and save Owner, the individual members (past, present and future), its successors, assigns, employees, agent, Engineers, and/or the harmless from, and against any and all claims, demands, damages, actions or causes of action by any party, together with any and all losses, costs or expenses in connection therewith or related thereto, including, but not limited to, attorney fees and costs of suit, for bodily injuries, death or property damage arising in or in any manner growing out of the work performed, or to be performed under this Contract. Contractor and its successors and assigns agree to indemnify the Owner, its individual members (past, present and future), its successors, assigns, employees, agents, and Engineers and against all fines, penalties or losses incurred for, including, but not limited to, attorney fees and costs of suit, or by reason of the violation by Contractor in the performance of this Contract, or any ordinance, regulation, rule of law of any political subdivision or duly constituted public authority. Without limiting the foregoing, the Contractor, at the request of Owner, its individual members (past and present), its successors, assigns, employees, agents, or Engineers, agrees to defend at the Contractor's expense any suit or proceeding brought against Owner, its individual members (past, present and future), its successors, assigns, employees, agents, Engineers due to, or arising out of the work performed by the Contractor.

.2 The Contractor assumes the entire risk, responsibility, and liability for any and all damage or injury of every kind and nature whatsoever (including death resulting therefrom) to all persons, whether employees of the Contractor or otherwise, and to all property (including the Work itself) caused by, resulting from, arising out of or occurring in connection with the execution of the Work, or in preparation for the Work, or any extension, modification, or amendment to the Work by the Change Order or otherwise. To the fullest extent permitted by law, the Contractor and its Surety shall indemnify and save harmless the Owner, the Architect, the Architect's consultants, and the respective agents and employees of any of them (herein collectively called the Indemnitees) from and against any and all liability, loss, damages, interest, judgments, and liens growing out of, and any and all costs and expenses (including, but not limited to, counsel fees and disbursements) arising out of, relating to or incurred in connection with the Work including, any and all claims, demands, suits, actions, or proceedings which may be made or brought against any of the Indemnitees for or in relation to any breach of the Contract for Construction or any violation of the laws, statutes, ordinances, rules, regulations, or executive orders relating to or in any way affecting the performance or breach of the Contract for Construction, whether or not such injuries to persons or damages to property are due or claimed to be due, in whole or in part, to any negligence of the Contractor or its employees, agents, subcontractors, or materialmen, excepting only such injuries and/or damages as are the result of the sole gross negligence of the Owner or Architect. To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect,

Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

#### ARTICLE 4 ARCHITECT/ENGINEER

##### § 4.1 General

§ 4.1.1 The Architect/Engineer is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect/Engineer as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

##### § 4.2 Administration of the Contract

§ 4.2.1 The Owner will provide administration of the Contract, through its Contracting Officer, as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect/Engineer or Contracting Officer issues the final Certificate for Payment. The Architect/Engineer or Contracting Officer will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

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§ 4.2.2 The Architect/Engineer will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect/Engineer will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect/Engineer will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect/Engineer will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect/Engineer will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect/Engineer will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

##### § 4.2.4 Communications

The Owner and Contractor shall include the Architect/Engineer in all communications that relate to or affect the Architect/Engineer's services or professional responsibilities. The Owner shall promptly notify the Architect/Engineer of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect/Engineer's consultants shall be through the Architect/Engineer. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.



§ 4.2.5 Based on the Architect/Engineer's evaluations of the Contractor's Applications for Payment, the Architect/Engineer will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect/Engineer has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect/Engineer considers it necessary or advisable, the Architect/Engineer will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect/Engineer nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect/Engineer to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect/Engineer will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect/Engineer's action will be taken in accordance with the submittal schedule approved by the Architect/Engineer or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect/Engineer's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect/Engineer's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect/Engineer's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect/Engineer's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect/Engineer will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect/Engineer will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect/Engineer will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect/Engineer agree, the Architect/Engineer will provide one or more Project representatives to assist in carrying out the Architect/Engineer's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect/Engineer will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect/Engineer's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect/Engineer will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect/Engineer will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect/Engineer's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The ~~Architect~~Architect/Engineer will review and respond to requests for information about the Contract Documents. The ~~Architect~~Architect/Engineer's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the ~~Architect~~Architect/Engineer will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

## ARTICLE 5 SUBCONTRACTORS

### § 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

### § 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and ~~Architect~~Architect/Engineer of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the ~~Architect~~Architect/Engineer may notify the Contractor whether the Owner or the ~~Architect~~Architect/Engineer (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the ~~Architect~~Architect/Engineer to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or ~~Architect~~Architect/Engineer has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or ~~Architect~~Architect/Engineer has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or ~~Architect~~Architect/Engineer has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or ~~Architect~~Architect/Engineer makes reasonable objection to such substitution.

### § 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and ~~Architect~~Architect/Engineer. Each subcontract agreement shall preserve and protect the rights of the Owner and ~~Architect~~Architect/Engineer under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

**§ 5.4 Contingent Assignment of Subcontracts**

**§ 5.4.1** ~~Each~~ Where applicable subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, ~~provided that, will not be valid unless:~~

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

**§ 5.4.2** Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

**§ 5.4.3** Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. ~~If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.~~

**ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS**

**§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts**

**§ 6.1.1** The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

**§ 6.1.2** When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

**§ 6.1.3** The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

**§ 6.1.4** Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

**§ 6.2 Mutual Responsibility**

**§ 6.2.1** The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

**§ 6.2.2** If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the ~~Architect~~Architect/Engineer of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the ~~Architect~~Architect/Engineer of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

#### § 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the ~~Architect~~Architect/Engineer will allocate the cost among those responsible.

### ARTICLE 7 CHANGES IN THE WORK

#### § 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

7.1.1.1 A field directive or field order shall not be recognized as having any impact upon the Contract Sum or the Contract Time and the Contractor shall have no claim therefor unless it shall, prior to complying with same and in no event no later than 10 working days from the date such direction or order was given, submit in writing to the Owner for the Owner's approval its change proposal.

7.1.1.2 When submitting its change proposal, the Contractor shall include and set forth in clear and precise detail breakdowns of labor and materials for all trades involved and the estimated impact on the construction schedule. The Contractor shall furnish spread sheets from which the breakdowns were prepared, plus spread sheets if requested of any Subcontractors.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.2.1 Neither this Contract nor the Work to be performed hereunder can be changed by oral agreement. No course of conduct or dealings between the parties, nor express or implied acceptance of alterations or additions to the Work and no claims that the Owner has been unjustly enriched by any alteration or addition to the Work, whether there is, in fact, any unjust enrichment to the Work, shall be the basis for any alleged implied agreement by the Owner to the change, any alleged waiver of the Owner's right under this Contract or any increase in any amounts due under the Contract or any or a change in any time period provided for in the Contract Documents.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.1.4 A directive or order from the owner or the Engineer, other than a change order, a construction change directive or any order for a minor change pursuant to this article 7, shall not be recognized as having any impact on the contract sum or the contract time and the contractor shall have no claim therefore. If the contractor believes that a directive or order would require it to perform work not required by the contract documents, the contractor shall so inform the owner in writing prior to complying with the same and in no event any later than five (5) working days from the day such direction or order was given, and shall submit to the owner for the owner's approval its change proposal.

**§ 7.2 Change Orders**

**§ 7.2.1** A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.2.2 Change Order shall include all costs, including cost of preparation of the change order, all impact and ripple costs associated with modifications or delays to the work an assessment of the amount and impact of any perceived potential delays, and all costs associated with modifications to other work.

.1 The Prime Contractor shall furnish all necessary documentation to support the additional cost, including but not limited to the following:

- .1 Copy of subcontractor's proposal.
- .2 Complete breakdown for all costs for labor and material.
- .3 Complete breakdown of related costs.
- .4 Other information as may be requested by the Owner.

§ 7.2.3 The overall cost of the Change Order shall be inclusive and once accepted by the Owner it shall be considered full and final.

§ 7.2.4 No additional time will be granted to the Contractor for minor change orders unless each individual change order totals more than \$50,000.

**Commented [CEG4]:** We should remind PMs that for any deduct change order, they should be aware and conscious of deducting OP.

§ 7.2.5 When a Change Order involves both additions and deletions in material, the net quantity is to be determined and the appropriate overhead and profit is to be applied to the net quantity.

§ 7.2.6 When any change in the Work, regardless of the reason therefore, requires or is alleged to require an adjustment in Contract Time, such request for time adjustment shall be submitted by the Contractor as part of the change proposal. Any Change Order approved by the Owner and for which payment is accepted by the Contractor, in which no adjustment in Contract Time is stipulated, shall be understood to mean that no such adjustment is required by reason of the change, and any and all rights of the Contractor or any subsequent request for adjustment of Contract Time by reason of the change is waived.

§ 7.2.7 Request by the Contractor for adjustment of the Contract Amount regardless of the reason therefore, shall be submitted to the Engineer and the Owner with itemized labor and material quantities and unit prices to permit proper evaluation of the request. A submission by the Contractor containing unsubstantiated lump sum requests for adjustment of the Contract Amount will not be considered by the Owner and Engineer. The Owner and Engineer will not be liable for any delay incurred by reason of the Contractor's failure to submit satisfactory justification and back-up with any request for adjustment to the Contract Amount.

§ 7.2.8 Agreement on any Change Order shall constitute a final settlement of all matters relating to the change in the initial Work which is the subject to the Change Order, including, but not limited to, all direct, indirect and impact costs associated with such change and any and all adjustment to the Contract Sum and the Construction Schedule. The Contractor will not be entitled to any compensation for additional work, impact costs or delays in the Construction Schedule not included in the Change Order.

**§ 7.3 Construction Change Directives**

**§ 7.3.1** A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

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§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

#### § 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

#### § 7.5 OVERTIME AUTHORIZED BY OWNER

§7.5.1 When work beyond the normal working hours for the trade is authorized by the Owner, for his own reasons, in writing, the Contract Sum shall be adjusted by Change Order on the basis of premium payment for labor only plus the actual extra cost for insurance and taxes based on this premium payment. Overhead and profit will not be paid by the Owner for overtime so authorized.

### ARTICLE 8 TIME

#### § 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The work to be performed under this Contract shall commence on May 19<sup>th</sup> 2021.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

#### § 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.2.4 Owner, or his representative, in coordination with the Contractor, shall set work hours. Contractor may be required to work nights, weekends or holidays as necessary to complete the work in accordance with the Schedule or in coordination with School Activities. Under no circumstances shall the Contractor begin or continue with work that is adversely impacting School activity or operations. All utility shutdowns, interruptions, work in or adjacent to existing buildings will be coordinated through the Owner, or his representative, and may have to be performed during hours when the School is not in operation. All cutting, hammering or other activity that is noisy, produces smoke or fumes or is otherwise disruptive to the School may have to be done during hours when the School is not in operation. Work required to be performed during non-school operating hours, as determined by the Owner or his representative, will be performed at no additional cost to the Owner.

§ 8.2.5 Contractor agrees to increase manpower, increase work hours, and to increase equipment necessary to maintain the Project Construction Schedule, and when also requested by the Architect/Engineer and the Owner, and shall be without additional cost or charge to the Owner.

§8.2.5 Work shall commence within ten (10) days of the issuance by Owner of a Notice to Proceed immediately and shall proceed uninterrupted to Final Completion. The Contractor acknowledges and recognizes that the Owner is entitled to full and beneficial occupancy and use of all or part of the completed Work in accordance with the Milestone Dates set forth in other sections of the Contract Documents, as per approved Schedule, and that the Owner has made arrangements to discharge its public obligations based upon the Contractor's achieving Substantial Completion of all of the Work within the Contract Time. The

Contractor further acknowledges and agrees that if the Contractor fails to complete substantially or causes a delay in the Substantial Completion of any portion of the Work as required by the Project Construction Schedule and/or within the Contract Time, the Owner will sustain extensive damages and serious loss as a result of such failure. The exact amount of such damages will be extremely difficult to ascertain. Therefore, the Owner and the Contractor agrees as set forth below.

- .1 If the Contractor fails to achieve partial completion within the requirements of the Milestone Dates or the approved Schedule or to achieve Substantial Completion of all or part of the Work when and as required by the Project Construction Schedule and/or within the Contract Time, the Owner shall be entitled to retain or recover from the Contractor and its Surety, as liquidated damages and not as a penalty, the amounts indicated in other sections of the Contract Documents and commencing upon the first day following expiration of the Project Construction Schedule and/or the Contract Time, as the case may be, and continuing until the actual Date of Substantial Completion.

#### §8.2.6 Adherence to Schedule

- .1 The Owner reserves the right to withhold monthly progress payments if the Contractor is behind schedule, unless the Contractor documents, in writing, any delays that are not the fault of the Contractor and to which the Owner and Engineer agree.
- .2 Monthly progress payments will only be released after the Contractor reaches the status of completion for that month contemplated by the construction schedule.

#### **§ 8.3 Delays and Extensions of Time**

**§ 8.3.1** If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

**§ 8.3.2** Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.2.1 Any claim for extension of time should be made in writing to the Owner not more than five (5) days after the commencement of the delay, otherwise, it shall be waived. The Contractor shall provide an estimate of the probable effect of such delay on the progress of the work. No claim made beyond the five (5) days shall be considered valid.

§ 8.3.2.2 The Contractor agrees that if any delay in the Contractor's works unnecessarily delays the work of any other Contractor or Contractors, the Contractor shall in that case pay all costs and expenses incurred by such parties due to such delays and hereby authorizes the Owner to deduct the amount of such costs and expenses from any moneys due or to become due the Contractor under this Contract. The Owner shall be responsible for ascertaining whether the Contractor is responsible for delaying any of the work of any other Contractor. His decision shall be final.

§ 8.3.3 Notwithstanding anything to the contrary in the Contract Documents, any extension of the Contract Time, to the extent permitted under Paragraph 8.3.1., shall be the sole remedy of the Contractor for any (1) delay in the commencement, prosecution or completion of the Work, (2) hindrance or obstruction in the performance of the Work, (3) loss of productivity or (4) other similar claims (collectively referred to in this Paragraph 8.3.3. as "delays"), whether or not such delays are foreseeable, unless a delay is caused by acts of the Owner constituting active interference with the Contractor's performance of the Work and only to the extent such acts continue after the Contractor furnishes the Owner with written notice of such interference. In no event shall the Contractor be entitled to any compensation or recovery of any damages in connection with any delay including without limitation consequential damages, lost opportunity cost, impact damages or other similar remuneration. The Owner's exercise of any of its rights or remedies under the Contract Documents (including without limitation ordering changes in the Work or directing suspension, rescheduling or correction of the Work) regardless of the extent or frequency of the Owner's exercise of such rights or remedies shall not be construed as an act of interference with the Contractor's performance of the Work



§ 8.3.4 The Contractor agrees that the Owner can deduct from the Contract Sum, any wages paid by the Owner to any Inspector or Engineer or other professional necessarily employed by the Owner for any number of days in excess of the number of days allowed in the specifications for completion of work..

§ 8.3.5 Where the cause of delay is due to weather conditions, an extension of time shall be granted only for unusually severe weather, as determined by reference to historical data. The term "historical data" as used in the previous sentence shall be construed according to this formula: Average rainfall (or snow or low temperature) for the past five years.

§ 8.3.3 The Contractor shall be precluded from the recovery of damages for delay or for any impacts resulting from delay. This preclusion shall apply for any delays described in paragraph 8.3.1, including (but not limited to) delays caused by an act or neglect on the part of the Owner or Engineer or of an employee of either. The Contractor's sole remedy for any delay (or resulting impacts) shall be an appropriate extension of time for the completion of the Contract. In the event that a Contractor asserts in an arbitration, lawsuit or proceeding of any type, an entitlement to money damages or other damages other than an extension of time in violation of this provision, the Owner and the Architect/Engineer shall be entitled to reasonable attorney's fees and costs incurred in the defense of that matter. Anything contained in the General Conditions of the Contract for Construction, AIA Document A201-2007 or as amended, the Supplementary Conditions, the Specifications, the Contract, the Drawings or any other document to the contrary notwithstanding, the Contractor shall not be entitled to damages or to extra compensation by reason of delays occasioned by the proceedings to review the awarding of the Contract to the Contractor or to review the awarding of any other Contract to any other Contractor. ~~§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.~~

## **ARTICLE 9 PAYMENTS AND COMPLETION**

### **§ 9.1 Contract Sum**

**§ 9.1.1** The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

**§ 9.1.2** If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

### **§ 9.2 Schedule of Values**

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

### **§ 9.3 Applications for Payment**

**§ 9.3.1** At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

**§ 9.3.1.1** As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

**§ 9.3.1.2** Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

#### § 9.4 Certificates for Payment

§ 9.4.1 The Architect/Engineer will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

#### § 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
  - .2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
  - .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
  - .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
  - .5 damage to the Owner or a Separate Contractor;
  - .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
- or

.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

- ~~.1 If the Contractor disputes any determination by the Owner with regard to any Certificate of Payment, the Contractor nevertheless expeditiously shall continue to prosecute the Work.~~
- ~~.2 The failure of the Owner to retain any percentage payable to the Contractor or any change in or variation of the time, method or condition of payments to the Contractor shall not release or discharge to any extent whatsoever the Surety upon any bond given by Contractor hereunder. The Owner shall have the right, but not the duty, to disregard any schedule of items and costs that the Contractor may have furnished and defer or withhold in whole or in part any payment if it appears to the Owner, in its sole discretion, that the balance available in the Contract Sum as adjusted and less retained percentages, may be insufficient to complete the Work.~~
- ~~.3 Notwithstanding any provision of any law to the contrary, the Contractor agrees that the time and conditions for payment under the Contract for Construction shall be as stated in the Contract for Construction and in the Contract Documents. The Contractor specifically agrees that Owner's failure to give, or timely give, notice of:~~
- ~~.1 any error in an invoice or application for payment submitted by the Contractor for payment; or~~
- ~~.2 any deficiency or non-compliance with the Contract Documents with respect to any Work for which payment is requested, shall not waive or limit any of the Owner's rights or defenses under the Contract for Construction and the Contract Documents, or require the Owner to make a payment in advance of the time, or in an amount greater than, as provided by the Contract for Construction.~~
- ~~.4 The Contractor shall make payments to its subcontractors in accordance with the provisions of any applicable law governing the time, conditions, or requirements for payment to its Subcontractors, and shall comply with the provisions of any such law.~~
- ~~.1 The Contractor will pay its Subcontractors no later than (15) fifteen days after receipt of a payment from the Owner which includes payment for the work of any such Subcontractors.~~
- ~~.2 The Contractor shall require its Subcontractors, by appropriate agreement, to pay their subcontractors and suppliers (of any tier) within the same time.~~
- ~~.3 The Contractor and its Surety shall indemnify and defend the Owner any loss, cost, expenses, or damages including attorney's fees, arising from or relating to the Contractor's failure to comply with such law.~~

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

- ~~.1 If the Contractor disputes any determination by the Owner with regard to any Certificate of Payment, the Contractor nevertheless expeditiously shall continue to prosecute the Work.~~
- ~~.2 The failure of the Owner to retain any percentage payable to the Contractor or any change in or variation of the time, method or condition of payments to the Contractor shall not release or discharge to any extent whatsoever the Surety upon any bond given by Contractor hereunder. The Owner shall have the right, but not the duty, to disregard any schedule of items and costs that the Contractor may have furnished and defer or withhold in whole or in part any payment if it appears to the Owner, in its sole discretion, that the balance available in the Contract Sum as adjusted and less retained percentages, may be insufficient to complete the Work.~~
- ~~.3 Notwithstanding any provision of any law to the contrary, the Contractor agrees that the time and conditions for payment under the Contract for Construction shall be as stated in the Contract for Construction and in the Contract Documents. The Contractor specifically agrees that Owner's failure to give, or timely give, notice of:~~
- ~~.1 any error in an invoice or application for payment submitted by the Contractor for payment; or~~
- ~~.2 any deficiency or non-compliance with the Contract Documents with respect to any Work for which payment is requested, shall not waive or limit any of the Owner's rights or defenses under the Contract for Construction and the Contract Documents, or require the Owner to make a payment in advance of the time, or in an amount greater than, as provided by the Contract for Construction.~~
- ~~.4 The Contractor shall make payments to its subcontractors in accordance with the provisions of any applicable law governing the time, conditions, or requirements for payment to its Subcontractors, and shall comply with the provisions of any such law.~~

~~.1 The Contractor will pay its Subcontractors no later than (15) fifteen days after receipt of a payment from the Owner which includes payment for the work of any such Subcontractors.~~

~~.2 The Contractor shall require its Subcontractors, by appropriate agreement, to pay their subcontractors and suppliers (of any tier) within the same time.~~

~~.3 The Contractor and its Surety shall indemnify and defend the Owner any loss, cost, expenses, or damages including attorney's fees, arising from or relating to the Contractor's failure to comply with such law.~~

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

#### § 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

### § 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

### § 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

### § 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

## § 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

## 9.11 LIQUIDATED DAMAGES

§ 9.11.1 ~~The Contractor understands and agrees that all work must be performed in an orderly and closely coordinated sequence so that the dates for substantial and Final completion ~~is~~are met.~~

§ 9.11.2 ~~If the Contractor fails to complete his work or fails to complete a portion of his work, he shall pay the Owner, as liquidated damages and not as a penalty, the sum as specified in the technical portion of the contract documents. Such amount is agreed upon as a reasonable and proper measure which the Owner will sustain each calendar day by failure of the Contractor to complete work within the stipulated time. Liquidated damages shall also apply to all Phased construction milestone dates as established by the phasing plan~~

§ 9.11.3 Substantial completion will be ~~determined~~ recommended by the Architect/Engineer, and ultimately determined by the Owner.

§ 9.11.4 For damage occurring at the time of delay, the Owner may retain the amount due to him under this clause from any payments due to the Contractor.

§ 9.11.5 The Owner will suffer financial loss if the project is not substantially complete on the date set forth in the Contract Documents. The Contractor (and the Contractor's Surety) shall be liable for and pay to the Owner the sum of \$ 1,000.00~~500.00~~ stipulated and fixed, agreed as liquidated damages for each calendar day of delay until the work is substantially complete.

§ 9.11.6 ONE THOUSAND (\$1,000.00) PER DAY ~~CALENDAR~~ DAY FOR PUNCH LIST ITEMS.

**Commented [CEG6]:** This number is a placeholder. PMs shall determine if LD's should be more (or in some instances, less).

## ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

### § 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.1.1 The Contractor must fully comply with the job safety requirements in addition to all Federal, State and Local safety guidelines. All cost associated with complying with all safety requirements shall be included in the Contract.

### § 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.2.1 Contractor shall comply with all regulations required by the Federal Occupational Safety and Health Act (OSHA).

§ 10.2.2.2 The Contractor shall conform to all applicable New Jersey Department of Environmental Protection regulations.

§ 10.2.2.3 Contractors must comply with Construction and Environmental Standards contained in Federal and State Regulations and other applicable laws.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities consistent with applicable laws, statutes, ordinances, codes, rules and regulations and lawful orders of public authorities, and prevailing industry practice.  
~~-of the safeguards.~~

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

**§ 10.2.8 Injury or Damage to Person or Property**

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.2.9 The Contractor shall provide and maintain in good operating condition suitable and adequate fire protection equipment, and shall comply with all reasonable recommendations regarding fire protection made by the representatives of the fire insurance company carrying insurance on the Work or by the local fire chief or fire marshal. The area within the site limits under the Contractor's control shall be kept orderly and clean, and all combustible rubbish shall be promptly removed from the site. Contractor will comply with all reasonable requests of the Owner and Engineer with respect to additional security and protections required for work interfacing with School Operations. Safety is of utmost importance on this project and all issues relative to safety and protection of the School, Staff and Students will be treated as emergency needs and will not be subject to the 7-day notice requirements of Article 14.

§ 10.2.10 The Contractor shall remove snow or ice which may accumulate on the site within areas under his control which might result in damage or delay.

§ 10.2.11 The Contractor shall take all precautions necessary to prevent loss or damage caused by vandalism, theft, burglary, pilferage, or unexplained disappearance of property of the Owner and Contractor, whether or not forming part of the Work, located within those areas of the Project to which the Contractor has access. Whenever unattended, including nights and weekends, mobile equipment and operable machinery shall be kept locked and made inoperable and immovable.

§ 10.2.12 Neither the Owner and/or the Engineer shall be responsible for providing a safe working place for the Contractor, the Subcontractors or their employees, or any individual responsible to them for the work.

§ 10.2.13 The Contractor shall conform to requirements of OSHA, the Construction Safety Code of the State Department of Labor and those of the AGC Manual. The requirements of the New Jersey and Local Building Construction Codes shall apply where there are equal to or more restrictive than the requirements of the Federal Act.

§ 10.2.14 When all or a portion of the Work is suspended for any reason, the Contractor shall securely fasten down all coverings and protect the Work as necessary from injury or any cause.

§ 10.2.15 The Contractor shall promptly report in writing to the Owner and Engineer all accidents arising out of or in connection with the Work which caused death, personal injury or property damage giving full details and



statements of any witnesses. In addition, if death, serious personal injury or serious property damage is caused, the accident shall be reported immediately by telephone or messenger to the Owner and Engineer.

§ 10.2.16 Contractor is required to follow and enforce the work rules set forth below. Failure to comply with or enforce any of these rules will be grounds for suspension and/or termination of this Contract:

- .1 No use of alcoholic beverages prior to or during working hours. Anyone found impaired after lunch will be escorted from the Project site.
- .2 No use of illegal drugs or prescription medications which could induce drowsiness or otherwise impair perception or performance. Use of illegal drugs may result in prosecution to the fullest extent of the law. Any warning associated with use of prescription drugs must be complied with, particularly warning against operation of machinery and equipment.
- .3 No horseplay or rough-housing will be allowed.
- .4 No sexual, racial, or ethnic harassment, or similar conduct will be tolerated.
- .5 All employees shall use proper sanitation habits including use of toilet facilities and garbage cans.
- .6 All employees shall dress in clothing appropriate for the work they are to perform. All personnel are to wear hardhats, safety shoes, glasses, gloves, masks or respirators, noise protection devices, and other protective clothing and equipment as required by OSHA standards.
- .7 All equipment is to be properly stored and/or secured at the end of the work day or if it is to remain idle for greater than one hour.
- .8 All personnel are to be made aware of the availability of Material Safety Data Sheets for materials used at the Project site. This information is available from the Contractor using the product. The Contractor shall maintain a copy of all MSDS forms at the construction site office for all personnel to review.

§ 10.2.17 Contractor shall protect adjoining private or municipal property and shall provide barricades, temporary fences and covered walkways required by prudent construction practices, local building codes, ordinances or other laws, or the Contract Documents.

10.2.18 In the event that contractor fails to comply with the provisions of the Section 10.2, the University may withhold from each invoice a percentage in addition to any other retainage required by the contract or the contract price in accordance with the following table:

<u>When Total Contract Price Is:</u>	<u>Percentage to be Withheld Is:</u>
<u>Less than \$250,000</u>	<u>10%</u>
<u>\$250,000 to \$1,000,000</u>	<u>5%</u>
<u>Over \$1,000,000</u>	<u>2%</u>

The withholding of any sums pursuant to this section shall not be construed as or constitute in any manner a waiver by the Owner of the contractor's obligation to comply with the provisions of this Section 10.2. In the event the contractor fails to comply with the provisions of this Section 10.2, the Owner shall have those rights and remedies provided by law and pursuant to this contract in addition to and not in lieu of the sums withheld in accordance with this section.

### **§ 10.3 Hazardous Materials and Substances**

**§ 10.3.1** The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

**§ 10.3.2** Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect

will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

~~§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.~~

~~§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.~~

~~§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.~~

~~§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.~~

#### § 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

### ARTICLE 11 INSURANCE AND BONDS

#### § 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 **Notice of Cancellation or Expiration of Contractor's Required Insurance.** Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from

an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

#### § 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 **Failure to Purchase Required Property Insurance.** If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 **Notice of Cancellation or Expiration of Owner's Required Property Insurance.** Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

#### § 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants, and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

#### § 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

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The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. ~~The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.~~

#### §11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

### ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

#### § 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

#### § 12.2 Correction of Work

##### § 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense. ~~If prior to the date of Substantial Completion the Contractor, a subcontractor or anyone for whom either is responsible, uses or damages any portion of the Work, including without limitation, mechanical, electrical, plumbing and other building systems, machinery, equipment or other mechanical device, the Contractor shall cause each such item to be restored to "like new condition" at no expense to the Owner.~~

##### § 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of ~~Substantial Completion~~Final Acceptance of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. ~~During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the~~

~~rights to require correction by the Contractor and to make a claim for breach of warranty.~~ If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after ~~Substantial Completion~~ Final Acceptance by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

### § 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

## ARTICLE 13 MISCELLANEOUS PROVISIONS

### § 13.1 Governing Law

The Contract shall be governed by the law of the ~~place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.~~ State of New Jersey and any dispute regarding the Contract shall be venued in Superior Court of New Jersey, Gloucester County.

### § 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

### § 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

#### § 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

#### § 13.5 Interest

~~§ 13.6.1. The Contractor shall not be entitled to any payment of interest for any reason, action or inaction by the Engineer or the Owner.~~

~~§ 13.6.2 Any payments withheld for time delays, faulty materials, or workmanship, shall not bear interest for period of delay or non-acceptance.~~

~~Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.~~

### ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

#### § 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment (~~without cause~~) within the time stated in the Contract Documents; or
- ~~.4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.~~

~~§ 14.1.2 If one of the above reasons exist, the Contractor may, upon fourteen (14) days written notice to the Owner, terminate the Contract, unless this reason is cured prior to the expiration of the notice, and recover from the Owner payment of work properly executed in accordance with the Contract Documents (the basis for such payment shall be as provided in the Contract) and for payment for cost directly related to work thereafter performed by Contractor in terminating such work including reasonable demobilization and cancellation charges provided said work is authorized in advance by Architect and Owner. The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.~~

~~§ 14.1.3 The Owner shall not be responsible for damages for loss of anticipated profits on work not performed on account of any termination described in Subparagraph 14.1.1 and 14.1.2. If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.~~

~~§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.~~

#### ~~§ 14.2 Termination by the Owner for Cause~~

~~§ 14.2.1 The Owner may terminate the Contract if the Contractor~~

- ~~.1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials and/or equipment;~~
- ~~.2 fails to make prompt payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;~~
- ~~.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or~~
- ~~.4 disregards the instructions of Engineer or Owner (when such instructions are based on the requirements of the Contract Documents).~~
- ~~.5 Is adjudged bankrupt or insolvent, or makes a general assignment for the benefit of Contractor's creditors, or a trustee or a receiver is appointed for Contractor or for any of its property, or files a petition to take advantage of any debtor's act, or to recognize under bankruptcy or similar laws; or~~
- ~~.6 Breaches any warranty made by the Contractor under or pursuant to the Contract Documents.~~
- ~~.7 Fails to furnish the Owner with assurances satisfactory to the Owner evidencing the Contractor's ability to complete the Work in compliance with the requirements of the Contract Documents.~~
- ~~.8 Fails after the commencement of the Work to proceed continuously with the construction and completion of the work for more than 10 days except as permitted under the Contract Documents.~~
- ~~.9 Otherwise does not fully comply with the Contract Documents.~~

~~otherwise is guilty of substantial breach of a provision of the Contract Documents.~~

~~§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:~~

- ~~.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;~~
- ~~.2 Accept assignment of subcontracts pursuant to Section 5.4; and~~
- ~~.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.~~

~~§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.~~

**§ 14.2.4** If the costs of finishing the Work, including compensation for the services of any consultants and the Architect's services and expenses made necessary thereby, and the other costs and expenses identified hereinafter, exceed the unpaid balance of the Contract Sum, the contractor and its Surety shall pay the difference to the Owner upon demand. The costs of finishing the Work include, without limitation, all reasonable attorney's fees, additional title costs, insurance, additional interest because of any delay in completing the Work, and all other direct and indirect consequential costs, including, without limitation, Liquidated Damages for untimely completion as specified in the Contract Documents, incurred by the Owner by reason of, or arising from, or relating to the termination of the Contractor as stated herein. If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

**§ 14.3 Suspension by the Owner for Convenience**

**§ 14.3.1** The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

**§ 14.3.2** The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

**§ 14.3.2** The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

**§ 14.4 Termination by the Owner for Convenience**

**§ 14.4.1** The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

**§ 14.4.2** Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

**§ 14.4.3** In case of such termination for the Owner's convenience, the Contractor shall be entitled to Owner payment for Work performed as of the date of termination in accordance with the contract Documents. The Contractor shall, as a condition of receiving the payments referred to herein, execute and deliver all such papers, turn over all plans, documents and files of whatsoever nature required by the Owner, and take all such steps, including the legal assignment of its contractual rights, as the Owner may require for the purpose of fully vesting in the Owner the rights and benefits of the Contractor. The Contractor warrants that it will enter into no subcontracts or other agreements that would adversely impact the Owner's rights or increase the Owner's obligations under this paragraph. In no event shall the Owner be liable to the Contractor for lost or anticipated profits or consequential damages, or for any amount in excess of the compensation due to the Contractor in accord with the Contract Documents for the Work performed as of the date of termination. The warranty and indemnity obligations of the Contractor and Surety shall survive and continue, notwithstanding any termination pursuant to this paragraph, with respect to the Work performed as of the date of termination.



§ 14.4.4 If Owner terminates the Contract for cause pursuant to Paragraph 14.2 and it is subsequently determined that the Owner was not authorized to terminate the Contract as provided in Paragraph 14.2, the Owner's termination shall be treated as a termination for convenience under this Paragraph 14.4 and the rights and obligations of the parties shall be the same as if the Owner has issued a notice of termination to the Contractor as provided in this Paragraph 14.4. In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

## ARTICLE 15 CLAIMS AND DISPUTES

### § 15.1 Claims

#### § 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

#### § 15.1.2 Time Limits on Claims

Issues involving the applicable statute of limitations shall be governed by New Jersey Law.

§ 13.7.1 No act or omission by the Owner or Engineer, or by anyone acting on behalf of either shall be deemed or construed as a waiver or limitation of any right or remedy under the Contract Documents, or as an admission, acceptance, or approval with respect to any breach of the Contract for Construction or failure to comply with the Contract Documents by the Contractor, unless the Owner expressly agrees, in writing.

§ 13.7.2 The Owner's exercise, or failure to exercise, any rights, claims or remedies it may have arising out of or relating to the Contract documents shall not release, prejudice, or discharge the Owner's other rights and remedies, nor shall it give rise to any right, claim, remedy or defense by any other person, including the Contractor, its Surety, any Subcontractor, or any other person or entity.

§ 13.7.3 Whenever possible, each provision of the Contract Documents shall be interpreted in a manner as to be effective and valid under applicable law. If, however, any provision of the Contract Documents, or portion thereof, is prohibited or found invalid by law, only such invalid provision or portion thereof shall be ineffective, and shall not invalidate or affect the remaining provision of the Contract Documents or valid portions of such provision, which shall be deemed severable. Further, if any provision of this Contract is deemed inconsistent with applicable law, applicable law shall control.

§ 13.8 Contractor shall promptly pay to Owner all costs and reasonable attorneys fees incurred in connection with any action or proceeding in which Owner prevails, based on a breach of the Contract or other dispute arising out of or in connection with the Contract.

§ 13.9 In the event of the appointment of a trustee and/or receiver or any similar occurrence affecting the management of the account of the Contractor pertaining to the Work, it shall be the obligation of the Contractor, its representatives, receivers, sureties, or successors in interest to continue the progress of the Work without delay and specifically to make timely payment to Subcontractors and Suppliers of all amounts that are lawfully due them and to provide the Owner and all Subcontractors and Suppliers whose work may be affected with timely notice of the status of receivership, bankruptcy, etc., and the status of their individual accounts.

~~§ 13.10 Regularly scheduled job meetings shall be held at a location and time convenient to the Owner's representatives, the Engineer and the Contractor. The Contractor shall attend such meetings, or be represented by a person in authority who can speak for and make decisions for the Contractor.~~

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

**§ 15.1.3 Notice of Claims**

**§ 15.1.3.1** Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

**§ 15.1.3.2** Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

**§ 15.1.4 Continuing Contract Performance**

**§ 15.1.4.1** Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

**§ 15.1.4.2** The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

**§ 15.1.5 Claims for Additional Cost**

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

**§ 15.1.6 Claims for Additional Time**

**§ 15.1.6.1** If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

**§ 15.1.6.2** If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

**~~§ 15.1.7 Waiver of Claims for Consequential Damages~~**

~~The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes~~

- ~~1 — damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and~~
- ~~2 — damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.~~

~~This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.~~

**§ 15.2 Initial Decision**

**§ 15.2.1** Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the

Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

~~§15.2.5.1 All claims and disputes and other matters in question between the Contractor and the Owner arising out of or relating to the Contract Documents or a breach thereof with regard to the Engineer's decision, shall be decided through suit in New Jersey Superior Court, Camden County, and Contractor consents to the jurisdiction of the New Jersey Superior Court. The Contractor shall carry on all work and maintain its progress during such suit and the Owner shall continue to make payments not related to the dispute of the Contractor in accordance with Contract Documents.~~

~~§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.~~

~~§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.~~

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

### ~~§ 15.3 Mediation~~

~~§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.~~

~~§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.~~

~~§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.~~

~~§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.~~

#### ~~§ 15.4 Arbitration~~

~~§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.~~

~~§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.~~

~~§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.~~

~~§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.~~

#### ~~§ 15.4.4 Consolidation or Joinder~~

~~§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).~~

~~§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.~~

~~§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.~~

#### ARTICLE 16 - AFFIRMATIVE ACTION REQUIREMENTS

##### 16.1 POLICY STATEMENT

It has long been the policy of the University to promote equal employment opportunity by prohibiting discrimination in employment and requiring affirmative action in the performance of contracts funded by the University. This policy has been reinforced and expanded by an act of the legislature. The new statute, New Jersey Public Law 1975, Chapter IR, provides that no public works contractor can be awarded nor any monies paid until the prospective contractor has agreed to contract performance, which complies with the approved affirmative action plan. The law applies to each political subdivision and agency of the State and includes procurement and service contracts as well as construction contracts. This section was prepared to explain the affirmative action requirements and procedures for public agencies awarding contracts and for contractors bidding on contracts. To assure effective implementation of the affirmative action law while allowing the business operations of a government to proceed efficiently, these regulations are designed to minimize administrative paperwork and delays.

##### 16.2 MANDATORY LANGUAGE

During the performance of this contract, the contractor agrees as follows:

- a) Where applicable, the contractor or sub-contractor will not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, sex, affectional or sexual orientation. The contractor will take affirmative action to insure that such applicants are recruited and employed and that employees are treated during employment without regard to their age, race, creed, color, national origin, ancestry, marital status, sex, affectional or sexual orientation. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, transfer, recruitment or recruitment advertising, lay-off or termination, rates of pay or other forms of compensation and the selection for training, including apprenticeship. The contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the public agency compliance officer setting forth provisions of this non-discrimination clause.
- b) Where applicable, the contractor or sub-contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, sex, affectional or sexual orientation.
- c) Where applicable, the contractor or sub-contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding a notice to be provided by the agency contracting officer advising the labor union or worker's representative of the contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
- d) Where applicable, the contractor or sub-contractor agrees to comply with any regulations promulgated by the Treasurer pursuant to P.L. 1975, c.127, as amended and supplemented from time to time.
- e) When hiring workers in each construction trade, the contractor or sub-contractor agrees to attempt in good faith to employ minority and female workers in each construction trade consistent with the applicable employment goal prescribed by N.J.A.C. 17:27-7.3 provided, however, that the affirmative action officer may, in its discretion, exempt a contractor or sub-contractor from compliance with the good faith procedures prescribed by the following provisions (a), (b) and (c) as long as the affirmative action office is satisfied that the contractor is employing workers provided by a union which provides evidence in accordance with standards prescribed by the affirmative action office that its percentage of active, "card carrying" members who are minority and female workers is equal to or greater than the applicable employment goal prescribed by N.J.A.C. 17:27-7.3 promulgated by the Treasurer pursuant to P.L. 1975, c.127, as amended and supplemented from time to time. The contractor or sub-contractor agrees that a good faith effort shall include compliance with the following procedures:
  - 1) If the contractor or sub-contractor has a referral agreement or arrangement with a union for a construction trade, the contractor or sub-contractor shall, within three (3) days of the contract award, seek assurances from the union that it will cooperate with the contractor or sub-contractor as it fulfills its affirmative action obligations under this contract and in accordance with the rules promulgated by the Treasurer pursuant to P.L. 1975, c.127, as it is amended and supplemented from time to time. If the contractor or sub-contractor is unable to obtain said assurances from the construction trade union at least five (5) days prior to the commencement of construction work, the contractor or sub-contractor agrees to directly attempt to hire minority and female workers

consistent with the applicable employment goal. If the contractor's or sub-contractor's prior experience with a construction trade union, regardless of whether the union has provided said assurances, indicates a significant possibility that the trade union will not refer sufficient minority and female workers consistent with the applicable employment goal, the contractor or sub-contractor agrees to be prepared to hire minority and female workers directly consistent with the applicable employment goal by complying with the hiring procedures prescribed under (2) below and the contractor or sub-contractor further agrees to take immediate said action if it determines or is so notified by the affirmative action office that the union is not referring minority and female workers consistent with the applicable employment goal.

2) If the hiring of a workforce consistent with the employment goal has not or cannot be achieved for each construction trade by adhering to the procedures of (1) above or if the contractor or sub-contractor does not have a referral agreement or arrangement with a union for a construction trade, the contractor or sub-contractor agrees to take the following actions consistent with the applicable county employment goals.

(a) to notify the public agency compliance officer, affirmative action office and at least one (1) approved minority referral organization of its manpower needs and request the referral of minority and female workers;

(b) to notify any minority and female workers who have been listed with it as awaiting available vacancies;

(c) prior to commencement of work to request the local construction trade union, if the contractor or sub-contractor has a referral agreement or arrangement with a union for the construction trade, to refer minority and female workers to fill job openings;

(d) to leave standing requests for additional referral to minority and female workers with the local construction trade union if the contractor or sub-contractor has a referral agreement or arrangement with a union for the construction trade, the State training and employment service and the other approved referral sources in the area until such time as the workforce is consistent with the employment goal;

(e) if it is necessary to lay-off some of the workers in a given trade on the construction site to assure, consistent with the applicable State and Federal statutes and court decisions, that sufficient minority and female employees remain on the site consistent with the employment goal and to employ any minority and female workers laid-off by the contractor or on any other construction site in the area on which its workforce composition is not consistent with an employment goal established pursuant to rules implementing P.L. 1975, c.127;

(f) to adhere to the following procedure when minority and female workers apply or are referred to the contractor or sub-contractor:

(i) If said individuals have never previously received any document or certification signifying a level of qualification lower than that required, the contractor or sub-contractor shall determine the qualifications of such individuals and, if the contractor's or sub-contractor's workforce in each construction trade is not consistent with the applicable employment goal, it shall employ such persons which satisfy appropriate qualification standards provided, however, that a contractor or sub-contractor shall determine that the individual at least possess the skills and experience recognized by any workers' skill and experience classification determination which may have been made by a public agency compliance officer, union, apprentice program or referral agency provided the referral agency is acceptable to the affirmative action office and provided further that, if necessary, the contractor or sub-contractor shall hire minority and female workers who qualify as trainees pursuant to these regulations. All of the requirements of this paragraph, however, are limited by the provisions of paragraph (3) below.

(ii) If the contractor's or sub-contractor's workforce is consistent with the applicable employment goal, the name of said minority or female group individual shall be maintained on a waiting list for the first consideration in the event the contractor's or sub-contractor's workforce is no longer consistent with the applicable employment goal.

(iii) If, for any reason, said contractor or sub-contractor determines that a minority individual or a female is not qualified or if the individual qualifies as

an advanced trainee or apprentice, the contractor or sub-contractor shall inform the individual in writing with the reasons for the determination and maintain a copy in its files and send a copy to the public agency compliance officer and to the affirmative action office.

(g) to keep a complete and accurate record of all requests made for the referral of workers in any trade covered by the contract on forms made available by the affirmative action office and shall be submitted promptly to that office upon request.

3) The contractor or sub-contractor agrees that nothing contained in (2) preceding provision shall preclude the contractor or sub-contractor from complying with the hiring hall or apprenticeship provisions in any applicable bargaining agreement or hiring hall arrangement and, where required by custom or agreement, it shall send journeymen and trainees to the union for referral or to the apprenticeship program for admission pursuant to such agreement or arrangement provided, however, that where the practices of a union or apprenticeship program will result in the exclusion of minorities and females or the failure to refer minorities and females consistent with the county employment goal, the contractor or sub-contractor shall consider for employment persons referred pursuant to said provisions (2) without regarding to such agreement or arrangement; provided further, however, that the contractor or sub-contractor shall not be required to employ minority and female advanced trainees and trainees in numbers which result in the employment of advanced trainees and trainees as a percentage of the total workforce for the construction trade which percentage significantly exceeds the apprentice to journey worker ratio specified in the applicable collective bargaining agreement or, in the absence of a collective bargaining agreement, exceeds the ratio established by practice in the area for said construction trade. Also, the contractor or sub-contractor agrees that in implementing the procedures of the preceding provisions (2) it shall, where applicable, employ minority and female workers residing within the geographical jurisdiction of the union.

4) The contractor agrees to complete an initial manning report on forms provided by the affirmative action office on in the form prescribed by the affirmative action office and submit a copy of said form no later than three (3) days after signing a construction contract provided, however, that the public agency may extend in a particular case the allowable time for submitting the form to no more than fourteen (14) days and to submit a copy of the monthly project manning report once a month by the seventh (7th) work day of each month thereafter for the duration of this contract to the affirmative action office and to the public agency compliance officer. The contractor agrees to cooperate with the public agency in the payment of budgeted funds as is necessary for on-the-job and off-the-job programs for outreach and training of minority and female trainees employed on the construction site.

5) The contractor and its sub-contractors shall furnish such reports or other documents to the affirmative action office as may be requested by the office from time to time in order to carry out the purposes of these regulations and public agencies shall furnish such information as may be requested by the affirmative action office for conducting a compliance investigation pursuant to Sub-Chapter 10 of the Administrative Code, N.J.A.C. 17:27.

# DRAFT AIA® Document A101™ - 2017

## Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the \_\_\_ day of \_\_\_\_\_ in the year 2018  
(In words, indicate day, month and year.)

BETWEEN the Owner:

Rowan University  
201 Mullica Hill Road  
Glassboro, NJ 08028

and the Contractor:

for the following Project:

[Renovations to Campbell Library – Phase 1](#)

The Architect:

[Kimmel Bogrette Architecture](#)  
482 Norristown Road, Suite 200  
Blue Bell, PA 19422

The Owner and Contractor agree as follows.

### ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101™-2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201™-2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

**ELECTRONIC COPYING** of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.



TABLE OF ARTICLES

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EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, Bid Solicitation, Bid Submission and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

Commented [CEG1]: Want to attach Bid Solicitation as Exhibit "A" and Bid Submission as Exhibit "B" if applicable.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be

- The date of this Agreement.
- A date set forth in a notice to proceed issued by the Owner.
- Established as follows:  
(Insert a date or a means to determine the date of commencement of the Work.)

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work. **TIME IS OF THE ESSENCE.**

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:  
 (Check one of the following boxes and complete the necessary information.)

- Not later than ( ) calendar days from the date of commencement of the Work.
- By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date
Entire Scope of Work	

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth below:

Liquidated damages of \$	per day for each calendar day substantial completion is not achieved.
Liquidated damages of \$	per day for each calendar day work on the closeout/punch list is incomplete

§ 3.4 By submission of the its Bid and execution of the Contract, the Contractor agrees that the time specified for Final Completion of the Work is a reasonable period for completion of the Work taking into consideration the average climatic range, material delivery time experience in the Contractor's industry.

§ 3.5 Should the Contractor fail to substantially complete the Work by the date set for Substantial Completion set forth above, the Contractor shall and hereby agrees to pay the Owner the sum of **\$1000 per day** for each consecutive calendar day which elapses between the above-referenced date set for Substantial Completion and the date of actual Substantial Completion as certified to and approved by the Owner. Should the Contractor fail to fully complete the Work in conformity with all provisions of the Contract by the date set for Final Completion set forth above, the Contractor shall and hereby agrees to pay the Owner the sum of **\$1000 per day** for each consecutive calendar day which elapses between the above-referenced date set for Final Completion and the date of actual Final Completion as certified to and approved by the Owner.

§ 3.6 The per day liquidated damages sum referenced herein is hereby agreed to be a reasonable and proper measure of damages which the Owner will sustain per diem by failure of Contractor to complete Work within time as stipulated; it being recognized by Owner and Contractor that the damages suffered by Owner which could result from a failure of the Contractor to complete the Work on schedule is uncertain and cannot be calculated with any degree of mathematical certainty. In no way shall costs of Liquidated Damages be construed as a penalty to the Contractor. In addition to liquidated damages, Owner shall have the right to recover the actual damages as are capable of being ascertained and which are not duplicative of elements covered by the liquidated damages provisions. Nothing in this paragraph shall limit the right of Owner to complete the Work following the Contractor's breach of contract.

**ARTICLE 4 CONTRACT SUM**

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be (\$ ), subject to additions and deductions as provided in the Contract Documents.

**§ 4.2 Alternates**

§ 4.2.1 Alternates, if any, are inclusive of the total Contract Sum:

Item	Price

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.

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 User Notes: (1834509656)

(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.3 Allowances, if any, included in the total Contract Sum reflected in Section 4.1:  
(Identify each allowance.)

Item	Price

§ 4.4 Unit prices, if any:  
(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit (\$0.00)

§ 4.5 Liquidated damages, if any:  
(Insert terms and conditions for liquidated damages, if any.)

See Sections 3.3, 3.4, 3.5, and 3.6 above.

§ 4.6 Other:  
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

Not Applicable.

**ARTICLE 5 PAYMENTS**

**§ 5.1 Progress Payments**

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month.

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the last day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the last day of the following month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than Forty Five ( 45 ) days after the Architect receives the Application for Payment.  
(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.3.1 **APPLICATIONS FOR PAYMENT:** The form for Applications for Payment shall be a notarized AIA Document G702, Application and Certification for Payment, supported by AIA document G703 Continuation Sheets. Each Application for Payment must be accompanied by three (3) sets of Certified Payroll Records for the period covered by the Application. The payroll records shall indicate the proper classification of employees and the payment of overtime, if any. These records shall include each Contractor's subcontractor's certified payroll. Payment will not be authorized if the required payroll records have not been submitted.

§ 5.1.3.2 All Applications for Payment, Certified Payroll Records and Manning Reports shall include the relevant purchase order number and project number.

§ 5.1.4 The Owner may decide to disapprove an Application for Payment, or withhold payment, in whole or in part, to the extent reasonably necessary to protect the Owner if, in its opinion, the representations as described in Section 5.1.4.1 below cannot be made. If the Owner withholds a Certificate for Payment, the Owner will notify the

Contractor as provided in Article 5 hereof. The Owner may also decide to withhold certifying payment in whole or in part, because of subsequently discovered evidence or subsequent observations, to such extent as may be necessary to protect the Owner from loss because of:

1. Defective Work which has not been remedied;
2. Third party claims filed or reasonable belief probable filing of such claims;
3. Failure of the Contractor to make payments properly to vendors, subcontractors or for labor, materials and equipment;
4. Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract sum;
5. Damage to the Owner or another contractor;
6. Reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
7. Failure to carry out the Work in accordance with the Contract Documents;
8. Avoidable delay in the progress of the Work;
10. Failure to maintain the Project Site in a safe and satisfactory condition in accordance with good construction practices as recommended by the Engineer after consultation with the Contractor; and
11. Failure to submit updates as requested by the Owner or as required by the General Conditions.

When the foregoing reasons for withholding payment are resolved, certification will be made for amounts previously withheld in the manner set forth in Section 5.1.3 above.

§ 5.1.4.1 The issuance of a separate Certificate for Payment will constitute representations by the Owner's Project Manager to the Owner, based on its individual observations at the Site and the data comprising the Application for Payment submitted by the Contractor, that the Work has progressed to the point indicated and that, to the best of the Owner's knowledge, information and belief, quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to minor deviations from the Contract Documents correctable prior to completion and to specific qualifications expressed by the Engineer. The issuance of a separate Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a separate Certificate for Payment will not be a representation that the Owner has: (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed the Contractor's construction means, methods, techniques, sequences or procedures; (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™-2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

*(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)*

Retainage shall be determined as follows: the Owner will withhold Five percent (5%) of the amount due on each partial payment when the outstanding balance of the Contract is more than \$500,000. When the outstanding balance of the Contract is Five Hundred Thousand Dollars (\$500,000.00) or less, Owner will withhold five percent (10%) as retainage. Retainage shall be withheld until the Owner determines that the work has been satisfactorily completed and no unsettled claims exist. The final acceptance shall not be binding or conclusive upon the Owner should it subsequently discover that the contractor has supplied inferior material or workmanship or has departed from the terms of his contract. Should such a condition appear the Owner shall have the right, notwithstanding final acceptance and payment, to cause the work to be properly done in accordance with the drawings and specifications at the cost and expense of the contractor.

§ 5.1.7.1.1 The following items are not subject to retainage:

*(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)*

None.

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:

*(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)*

None.

§ 5.1.7.3

Intentionally Omitted.

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner’s prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- .1 the Contractor has fully performed the Contract except for the Contractor’s responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner’s final payment to the Contractor shall be made no later than 45 days after the issuance of the final Certificate for Payment.

« »

### § 5.3 Interest

Payments due and unpaid under the Contract shall bear no interest from the date payment is due at the rate stated below.

## ARTICLE 6 DISPUTE RESOLUTION

### § 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.

### § 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:

(Check the appropriate box.)

Arbitration pursuant to Section 15.4 of AIA Document A201–2017

Litigation in New Jersey Superior Court, Gloucester County.

Other (Specify)

« »

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

## ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

« »

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

## ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:

(Name, address, email address, and other information)

Project Manager

Rowan University  
201 Mullica Hill Road  
Glassboro, NJ 02028

@rowan.edu

§ 8.3 The Contractor's representative:

(Name, address, email address, and other information)

§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

**§ 8.5 Insurance and Bonds**

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™-2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™-2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201-2017, may be given in accordance with AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:

*(If other than in accordance with AIA Document E203-2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)*

« »

§ 8.7 Other provisions:

§8.8 It is the obligation of the Contractor to provide a full and complete copy of all insurance policies held by it at the Contractor's sole expense, upon reasonable request by the Owner, in the amounts specified in the Bid Documents ( see Article 11 of modified AIA Document A201-2007 General Conditions of the Contract for Construction). The Contractor's failure to obtain or maintain adequate insurance coverage shall result in the immediate termination of this Agreement. The Owner will have the right to request copies of the Contractor's insurance policies or any part thereof for the duration of the contract period.

§8.9 This Agreement, the General Conditions of the Contract as modified or supplemented in writing, and the Supplemental General Conditions shall control in the case of conflict between these documents and the Project Specifications, the Project Manual and any other exhibits incorporated by reference into this Agreement in Article 9 herein.

**ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS**

§ 9.1 This Agreement is comprised of the following documents:

- .1 AIA Document A101™-2017, Standard Form of Agreement Between Owner and Contractor
- .2 AIA Document A101™-2017, Exhibit A, Insurance and Bonds
- .3 AIA Document A201™-2017, General Conditions of the Contract for Construction
- .4 Drawings: None
- .5 Project Manual

Section	Title	Date	Pages

<b>DIVISION 01 GENERAL REQUIREMENTS DATED October 4, 2018</b>			
<b>Section</b>	<b>Title</b>	<b>Date</b>	<b>Pages</b>

**TECHNICAL SPECIFICATIONS**

<b>Section</b>	<b>Title</b>	<b>Date</b>	



.7 Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

.8 Other Exhibits:

(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

AIA Document E204™-2017, Sustainable Projects Exhibit, dated as indicated below:  
(Insert the date of the E204-2017 incorporated into this Agreement.)

The Sustainability Plan:

Title	Date	Pages

Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents, if any, listed below:

(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™-2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

The Bid Package attached hereto as Exhibit "A"  
Contractor's Bid attached hereto as Exhibit "B"

This Agreement entered into as of the day and year first written above.

\_\_\_\_\_  
OWNER (Signature)

\_\_\_\_\_  
CONTRACTOR (Signature)

\_\_\_\_\_  
Joseph Scully, CFO



# PLANNING AND CONSTRUCTION

# ALLOWANCE AUTHORIZATION

Project: _____	Allowance Authorization Number: _____
_____	Date: _____
Vendor: _____	RU Project Number: _____
_____	PO Number: _____

You are authorized to perform the following item(s) of work and to adjust the Allowance Sum accordingly:

This authorization is due to:

- Owners Request  
 Field Condition Requirement  
 Unforeseen Condition  
 Design Error/Omission  
 DCA Request

Explain:

**THIS IS NOT A CHANGE ORDER AND DOES NOT INCREASE OR DECREASE THE CONTRACT AMOUNT**

Original Allowance .....	\$
Allowance Expenditures prior to this Authorization.....	\$
Allowance Balance prior to this Authorization.....	\$
Allowance will be [increased] [decreased] by this Authorization.....	\$
New Allowance Balance.....	\$

### APPROVAL RECOMMENDED

\_\_\_\_\_ Date

\_\_\_\_\_ Date  
VP Administration and Finance  
(amounts >\$30,099.99)

\_\_\_\_\_ Date

AVP Facilities  
(amounts > \$6,019.99)

Attachments

Copies:  Owner    Contractor    Consultants    \_\_\_\_\_    \_\_\_\_\_    \_\_\_\_\_    File



## PLANNING AND CONSTRUCTION

## ALLOWANCE CHARGE REQUEST (PROPOSAL)

---

Project: \_\_\_\_\_ Allowance Charge Request Number: \_\_\_\_\_  
\_\_\_\_\_ From (Contractor): \_\_\_\_\_  
To: \_\_\_\_\_ Date: \_\_\_\_\_  
\_\_\_\_\_ RU Project Number: \_\_\_\_\_  
Re: \_\_\_\_\_ PO Number: \_\_\_\_\_

---

This Allowance Charge Request contains charges to be made against the contract allowance

---

Description of Proposed Charge:

Attached supporting information from:  Subcontractor  Supplier  \_\_\_\_\_

---

Reason for Charge:

---

Attached pages:  Proposal Worksheet Summary:  
 Proposal Worksheet Details:

---

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

Copies:  Owner  Contractor  Consultants  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  File

---



*Facilities Planning & Construction*

<b>REQUEST FOR INFORMATION</b>			
RFI No:			
Rowan Project No./Description:	Date Submitted:		Requested Response Date:
			Actual Response Date:
Rowan Project Manager:			
Submitted to:			
Company:			
Contract Document Reference:			
<b>RFI DISCUSSION</b>	Individually number each separate topic or question		
Submitted by (Name & Company):	Title:	Date:	
<b>RFI RESPONSE</b>			
Answered by (Name & Company):	Title:	Date:	

# CHANGE ORDER REQUEST

OWNER   
ARCHITECT   
CONTRACTOR   
FIELD   
OTHER

---

PROJECT: (name, address)

CHANGE ORDER REQUEST NUMBER:

DATE OF ISSUANCE:

ARCHITECT'S PROJECT NO:

CONTRACT FOR:

OWNER: (name, address)

CONTRACT DATE:

ARCHITECT: (name, address)

FROM CONTRACTOR: (name, address)

---

The contractor must submit this proposal with all appropriate documentation and/or notify the Architect or Owner, in writing, of the date on which proposal submission is anticipated.

**THIS IS NOT A CHANGE ORDER, A CONSTRUCTION DIRECTIVE OR A DIRECTION TO PROCEED WITH THE WORK DESCRIBED IN THE PROPOSED MODIFICATIONS.**

DESCRIPTION: (Insert a written description of the Work)

ATTACHMENTS: (List attached documents that support description)

---

REQUESTED BY THE CONTRACTOR:

---

*(Signature)*

---

*(Printed Name and title)*

# CHANGE ORDER

OWNER   
ARCHITECT   
CONTRACTOR   
FIELD   
OTHER

PROJECT:  
(name, address)

CHANGE ORDER NUMBER:

DATE:

TO CONTRACTOR:  
(name, address)

ARCHITECT'S PROJECT NO:

CONTRACT DATE:

CONTRACT FOR:

PURCHASE ORDER NO:

The Contract is changed as follows:

---

**Not valid until signed by the Owner, Architect and Contractor.**

---

The original (Contract Sum) (Guaranteed Maximum Price) was  
New change by previously authorized Change Orders  
The (Contract Sum) (Guaranteed Maximum Price) prior to this Change Order was  
The (Contract Sum) (Guaranteed Maximum Price) will be (increased) (decreased)  
(unchanged) by this Change Order in the amount of  
The new (Contract Sum) (Guaranteed Maximum Price) including this Change Order will be

The Contract Time will be (increased) (decreased) (unchanged) by ( ) days.  
The date of Substantial Completion as of the date of this Change Order therefore is

NOTE: This summary does not reflect changes in the Contract Sum, Contract Time or Guaranteed Maximum Price which have been authorized by Construction Change Directive.

_____ ARCHITECT	_____ CONTRACTOR	_____ Rowan University OWNER
_____ Address	_____ Address	_____ 201 Mullica Hill Road Address
_____ BY _____	_____ BY _____	_____ Glassboro, NJ 08028-1701 BY _____
_____ DATE _____	_____ DATE _____	_____ DATE _____

---

PROJECT NAME \_\_\_\_\_  
 CONTRACTOR \_\_\_\_\_  
 SUBCONTRACTOR \_\_\_\_\_

PROJECT NO. \_\_\_\_\_  
 CONTRACT NO. \_\_\_\_\_  
 DATE \_\_\_\_\_

## HOURLY LABOR RATE BREAKDOWN FORM

All Contractors (Including sub-subcontractors) need to include a detailed breakdown of all wage rates, payroll burden costs and material costs for lump sum and time and material extras. Payroll burden items, FICA, FUI, SUI, and Workmen's Compensation will be reimbursed on an average annualized basis. **This information must be provided for all trade to be utilized on the project by any and all contractors at the time of contractors bid submission.** The required format is as follows:  
 (Reference 'Change Orders' in AIA 201 General Conditions. Certified payrolls required for all workers on Project.)

TRADE: \_\_\_\_\_

CLASSIFICATION: \_\_\_\_\_

Item	Rate Per \$100	Prevailing Wage Rate			Notes
		Regular Time	Overtime	Double Time	
Base Labor Rate					Use certified payroll to verify.
Fringe Benefits:					
Pension <sup>1</sup>					
Annuity Fund <sup>1</sup>					
Health/Welfare <sup>1</sup>					
Training/Certification <sup>1</sup>					
Vacation <sup>1</sup>					
Paid Holiday <sup>1</sup>					
Associate Dues <sup>1</sup>					
Other <sup>1</sup>					
Fringe Benefits Subtotal					
Total PW Hourly Rate					= Base Labor Rate + Benefits
Benefits Paid					
Total Paid Hourly Rate					= Base Labor Rate + Benefits
Burden: Taxes & Insurance <sup>2</sup>					
FICA					
Medicare					
Federal Unemployment					
State Unemployment					Maximum - 0.062.
Workers Compensation <sup>1</sup>					Usually less than 11%; can
Other <sup>1</sup>					
Other <sup>1</sup>					
Burden Subtotal					
Contractor Liability Insurance		N/A	N/A	N/A	Included in OH&P
Small Tools		N/A	N/A	N/A	Included in OH&P
Other (warranty, record drawings, payment bonds, performance bonds, etc.)		N/A	N/A	N/A	Included in OH&P
<b>TOTAL HOURLY RATE (Total Hourly Rate + Burden)</b>					= Amount Contractor paid to employee

Note: For change order work, mark-ups for overhead and profit shall be applied to the above rates (these rates are subject to audit) in accordance with the provisions of AIA 201 General Conditions, under 'Change Orders'.

<sup>1</sup> Costs for Overtime and Double Time are same as for Regular Time.

<sup>2</sup> Taxes & Insurance apply to Total Paid Hourly Rate which includes Base Labor Rate plus benefits paid in cash.

By signing below, the submitter certifies and declares under penalty of perjury under the laws of the State of New Jersey that the foregoing is true and correct.

Rates certified by: \_\_\_\_\_  
 (print name)

Company Name: \_\_\_\_\_

Signature: \_\_\_\_\_

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

PROJECT NAME: **Superiority Hall Renovation Project**  
 CONTRACTOR: **Cut No Corners Contractors**  
 SUBCONTRACTOR: **Don Write Electrical**

PROJECT NO.: **RU00000**  
 CONTRACT NO.: **PO000000**  
 DATE: **1/1/2019**

### HOURLY LABOR RATE BREAKDOWN FORM

All Contractors (Including sub-subcontractors) need to include a detailed breakdown of all wage rates, payroll burden costs and material costs for lump sum and time and material extras. Payroll burden items, FICA, FUI, SUI, and Workmen's Compensation will be reimbursed on an average annualized basis. **This information must be provided for all trade to be utilized on the project by any and all contractors at the time of contractors bid submission.** The required format is as follows:  
 (Reference 'Change Orders' in AIA 201 General Conditions. Certified payrolls required for all workers on Project.)

TRADE: **Electrical**

CLASSIFICATION: **Electrical Forman**

Item	Rate Per \$100	Prevailing Wage Rate			Notes	
		Regular Time	Overtime	Double Time		
Base Labor Rate		\$ 37.40	\$ 56.10	\$ 74.80	Use certified payroll to verify.	
	Benefit Paid	Benefit Provided				
Fringe Benefits:	put X in appropriate box					
Pension <sup>1</sup>		X	5.65	5.65	5.65	
Annuity Fund <sup>1</sup>		X	-	-	-	
Health/Welfare <sup>1</sup>	X		10.40	10.40	10.40	
Training/Certification <sup>1</sup>	X		0.70	0.70	0.70	
Vacation <sup>1</sup>		X	-	-	-	
Paid Holiday <sup>1</sup>		X	-	-	-	
Associate Dues <sup>1</sup>		X	-	-	-	
Other <sup>1</sup>		X	0.41	0.41	0.41	
Fringe Benefits Subtotal			\$ 17.16	\$ 17.16	\$ 17.16	
Total PW Hourly Rate			\$ 54.56	\$ 73.26	\$ 91.96	= Base Labor Rate + Benefits
Benefits Paid			\$ 11.10	\$ 11.10	\$ 11.10	
Total Paid Hourly Rate			\$ 48.50	\$ 67.20	\$ 85.90	= Base Labor Rate + Benefits
Burden: Taxes & Insurance <sup>2</sup>						
FICA	0.0620		3.01	4.17	5.33	
Medicare	0.0145		0.70	0.97	1.25	
Federal Unemployment	0.0080		0.39	0.54	0.69	
State Unemployment			-	-	-	Maximum - 0.062.
Workers Compensation <sup>1</sup>			-	-	-	Usually less than 11%; can
Other <sup>1</sup>			-	-	-	
Other <sup>1</sup>			-	-	-	
Burden Subtotal			\$ 4.10	\$ 5.68	\$ 7.26	
Contractor Liability Insurance			N/A	N/A	N/A	Included in OH&P
Small Tools			N/A	N/A	N/A	Included in OH&P
Other (warranty, record drawings, payment bonds, performance bonds, etc.)			N/A	N/A	N/A	Included in OH&P
<b>TOTAL HOURLY RATE (Total Hourly Rate + Burden)</b>			<b>\$ 58.66</b>	<b>\$ 78.94</b>	<b>\$ 99.22</b>	= Amount Contractor paid to employee

Note: For change order work, mark-ups for overhead and profit shall be applied to the above rates (these rates are subject to audit) in accordance with the provisions of AIA 201 General Conditions, under 'Change Orders'.

<sup>1</sup> Costs for Overtime and Double Time are same as for Regular Time.

<sup>2</sup> Taxes & Insurance apply to Total Paid Hourly Rate which includes Base Labor Rate plus benefits paid in cash.

By signing below, the submitter certifies and declares under penalty of perjury under the laws of the State of New Jersey that the foregoing is true and correct.

Rates certified by: **Don Write**  
 (print name)

Company Name: **Don Write Electrical**

Signature: *Don Write*

Date: **1/1/2019**



**DAILY JOB REPORT**

**Project #**

**DATE:**

**WEATHER CONDITIONS:**

**VISITORS:**

<b>CONTRACTORS ON SITE:</b>	<b>SUPER ON SITE (Y/N):</b>	<b>WORKFORCE ON SITE: (Foreman, Tradesmen, Laborers, etc.)</b>	<b>NO. OF WORKERS</b>	<b>WORK BEING DONE:</b>

**MATERIALS DELIVERED:**

**EQUIPMENT ONSITE:**

**PROBLEMS/STATUS/CAUSES FOR DELAY:**

**NOTEWORTHY PHONE CALLS:**

# APPLICATION AND CERTIFICATE FOR PAYMENT

AIA DOCUMENT G702

TO OWNER:

PROJECT:

APPLICATION NO:

PERIOD TO:

PROJECT/CONTRACT NO:

FROM CONTRACTOR:

VIA ENGINEER:

CONTRACT DATE:

APPLICATION DATE:

## CONTRACTOR'S APPLICATION FOR PAYMENT

CHANGE ORDER SUMMARY		ADDITIONS	DEDUCTIONS
Change Orders approved in previous months by owner			
TOTAL			
Approved This Month Number	Date Approved		
TOTALS			
Net Change By Change Orders			

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:

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

Application is made for Payment, as shown below, in connection with the Contract. Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM.....
2. Net change by Change Orders.....
3. CONTRACT SUM TO DATE (LINE 1 + 2).....
4. TOTAL COMPLETED & STORED TO DATE.....  
{Column G on G703}
5. Retainage:
  - a. \_\_\_\_\_ % of Completed Work.....  
{Column D + E on G703}
  - b. 0 % of Stored Materials.....  
{Column f on G703}
 Total Retainage (line 5a + 5b or Total in Column I of G703).....
6. TOTAL EARNED LESS RETAINAGE.....  
{Line 4 less Line 5 Total}
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificate).....
8. CURRENT PAYMENT DUE.....
9. BALANCE TO FINISH, PLUS RETAINAGE.....  
{Line 3 less Line 6}

State \_\_\_\_\_ County of: \_\_\_\_\_  
 Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_ 2010  
 Notary Public: \_\_\_\_\_  
 My Commission expires: \_\_\_\_\_

AMOUNT CERTIFIED..... \$ \_\_\_\_\_

{Attach explanation if amount certified differs from the amount applied for.}

ARCHITECT:

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

This Certificate is not negotiable. THE AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

## ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, Based on on-site observations and the data comprising the above application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.



Attachment to G702 (or equivalent)  
Certification for Payment

Project Name: \_\_\_\_\_  
Project Number: \_\_\_\_\_ Payment Number: \_\_\_\_\_

I, \_\_\_\_\_, a prime contractor working for Rowan University on the above-mentioned project, hereby certify as required by P.L. 191, c.507 of the State of New Jersey that: **(you must check one under "A" and one under "B")**

A. . With respect to previous progress payments:

- ( ) all my sub-contractors and suppliers have been paid all amounts due from all previous progress payments I have received from Rowan University for my work on this project
- ( ) all my sub-contractors and suppliers have been paid all amounts due from all previous progress payments with the exception of those listed below for which payment is being withheld as there exists a valid basis for those sub-contractors and suppliers listed below under the terms of their contract(s) to withhold payment from each such sub-contractor and supplier:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

For each such sub-contractor and supplier for which payment is being withheld, I further certify that written notice detailing the specific reason(s) for withholding payment has been provided to each such sub-contractor and supplier with copies

thereof provided to my performance bond company and Rowan University.

B. With respect to this payment number\_\_\_\_\_:

- ( ) all my sub-contractors and suppliers shall be paid all amounts due from this progress payment
- ( ) all my sub-contractors and suppliers shall be paid all amounts due from this progress payment with the exception of those listed below for which payment will be withheld as there exists a valid basis for those sub-contractors and suppliers listed below under the terms of their contract(s) to withhold payment from each such sub-contractor and supplier:

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

For each sub-contractor and supplier for which payment is being withheld, I further certify that written notice detailing the specific reason(s) for withholding payment has been provided to each sub-contractor and supplier with copies thereof provided to my performance bond company and Rowan University.

I certify that the above statements are true. I am aware that if any of the above statements are willfully false, I am subject to punishment.

Dated: \_\_\_\_\_

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Please Print Name

**CONTRACTOR'S PARTIAL OR FINAL RELEASE AND WAIVER OF LIENS**

**OWNER:**

**CONTRACT FOR:**

**OWNER'S AGENT:**

**PROJECT:**

**CONTRACT DATE:**

Upon receipt by the undersigned Contractor of a check from Owner in the sum of \$ \_\_\_\_\_, which check will consume payment of all sums due the Contractor for labor, equipment and/or materials supplied in connection with the Project, and when said check has been paid by the bank upon which it is drawn, this document shall become effective to fully and finally waive and release any and all liens, claims, liabilities, actions, and demands that this Contractor and all its subcontractors have or might have against Owner, Lender, the Project, the real property upon which the Project is located and any and all other property owned by Owner on account of or in connection with labor, equipment and/or materials supplied by the undersigned to the Project.

The undersigned Contractor does hereby further acknowledge and represent that through the date hereof the undersigned has received payments totaling \$ \_\_\_\_\_ for labor, equipment and/or materials supplied to the Project.

This instrument has been executed as of the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

**CONTRACTOR:**

\_\_\_\_\_

By: \_\_\_\_\_

Name: \_\_\_\_\_

Title: \_\_\_\_\_

STATE OF \_\_\_\_\_                      δ

δ

COUNTY OF \_\_\_\_\_                  δ

Sworn to and subscribed before me the undersigned authority on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

[ S E A L ]

My Commission Expires:

\_\_\_\_\_

\_\_\_\_\_  
Notary Public, State of \_\_\_\_\_

\_\_\_\_\_  
Printed Name of Notary Public



To Whom It May Concern:

Your recent request to Rowan University requesting information or a tax exempt form is hereby acknowledged.

It has been determined that Rowan University is a government body and is Exempt from New Jersey Sales and Use Taxes imposed by the Sales and Use Tax Act (P.L. 1966, c.30 and c.52). An opinion from the State of New Jersey, Office of the Attorney General has been reproduced below.

If you have any questions, please contact the Accounts Payable Office at (856) 256-4115.

Sincerely,

*Joseph F. Scully, Jr.*  
Joseph F. Scully, Jr.  
Vice President for Finance & CFO



State of New Jersey  
OFFICE OF THE ATTORNEY GENERAL  
DEPARTMENT OF LAW AND PUBLIC SAFETY  
DIVISION OF LAW  
25 MARKET STREET  
PO Box 112  
TRENTON, NJ 08625-0112

CHRIS CHRISTIE  
Governor

KIM GUADAGNO  
Lt. Governor

PAULA T. DOW  
Attorney General

ROBERT M. HANNA  
Director

May 4, 2011

Joseph F. Scully, Jr.  
Vice President for Finance & CFO  
Rowan University  
Bole Hall  
201 Mullica Hill Road  
Glassboro, NJ 08028-1701

Re: Tax Exempt Status of Rowan University  
Federal Tax ID #222-764-819

Dear Mr. Scully:

You have asked this office for an opinion whether Rowan University is obligated to pay New Jersey sales and use taxes in the conduct of the University's business.

You are hereby advised that, pursuant to N.J.S.A. 54:32B-9, any sales, service or amusement charge by or to the University or any use or occupancy by the University is not subject to taxes imposed by the New Jersey Sales and Use Tax Act, N.J.S.A. 54:32B-1 *et seq.*, where the University or its authorized representative conducting University business, is the purchaser, user or consumer. Further, should the United States or any other state grant an exemption from certain taxes to the State of New Jersey, Rowan University, as an arm of the State, is entitled to such consideration.

Sincerely yours,

PAULA T. DOW  
ATTORNEY GENERAL OF NEW JERSEY

By: *Cheryl R. Clarke*  
Cheryl R. Clarke  
Deputy Attorney General

CRC/zd



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Chief Financial Officer  
Bole Hall  
201 Mullica Hill Road  
Glassboro, NJ 08028-1701

856-256-4127  
856-256-4443 fax

**CONSENT OF  
SURETY COMPANY  
TO FINAL PAYMENT**

AIA DOCUMENT G707

OWNER   
ARCHITECT   
CONTRACTOR   
SURETY   
OTHER

PROJECT:  
(name, address)

TO (Owner)

ARCHITECT'S PROJECT NO.:  
CONTRACT FOR:

CONTRACT DATE:

CONTRACTOR:

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the  
(there insert name and address of Surety Company)

, SURETY COMPANY,

on bond of (there insert name and address of Contractor)

, CONTRACTOR,

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not  
relieve the Surety Company of any of its obligations to (there insert name and address of Owner)

, OWNER,

as set forth in the said Surety Company's bond.

IN WITNESS WHEREOF,  
the Surety Company has hereunto set its hand this

day of

2017

\_\_\_\_\_  
Surety Company

\_\_\_\_\_  
Signature of Authorized Representative

\_\_\_\_\_  
Title

Attest:  
(Seal):

NOTE: This form is to be used as a companion document to AIA DOCUMENT G706, CONTRACTOR'S AFFIDAVIT OF PAYMENT OF DEBTS AND  
CLAIMS, Current Edition



## Renovations to Campbell Library – Phase 1

Rowan University  
Rowan Project No. 77154

PROJECT MANUAL

Kimmel Bogrette Architecture  
KBAS Project No. 21-008

### SECTION 011000 - SUMMARY

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Work covered by the Contract Documents
  - 2. Contract
  - 3. Specification formats and conventions
  - 4. Use of premises.
- B. Related Sections include the following:
  - 1. Division 01 Section “Construction Facilities and Temporary Controls” for limitations and procedures governing temporary use of Owner’s premises.

##### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification:
  - 1. Project Location: Rowan University, Glassboro, New Jersey
    - a. Renovations to Campbell Library - Phase 1
  - 2. Owner: Rowan University
- B. Architect Identification: The Contract Documents were prepared for Project by:
  - 1. Kimmel Bogrette Architecture + Site  
482 Norristown Road, Suite 200  
Blue Bell, PA 19422
- C. The Work consists of the following:
  - 1. The scope of work shall not be limited to what is specifically called out on the drawings and/or specifications, but shall include any and all demolition, temporary work, protection of stockpiled materials for re-use, dewatering, cutting and patching, temporary protection and shoring, and all work as required to accomplish the intended construction.
  - 2. The contractor will be permitted to conduct their building surveys once the letter of award is issued. Contractor shall also begin the submittal process.
  - 3. Contractor must outline in their bid any long lead items that may impact their ability to meet the deadlines of the schedule. Failure to advise of long lead items shall preclude Contractor from right to additional time and/or costs associated with such delay.

## Renovations to Campbell Library – Phase 1

Rowan University

PROJECT MANUAL

Kimmel Bogrette Architecture

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4. Rowan University has submitted the Plans and Specification to The Department of Community Affairs (DCA) for the Plan Review Process.
5. Contractor is responsible for submitting and securing all necessary permits to complete the work.
6. Bid shall include all work shown on the Contract Drawings, Technical Specifications, and other documents issued under this IFB.
7. Contractor must follow all OSHA and Rowan safety guidelines and procedures.
8. Contractor shall Schedule and Coordinate all work activities with Rowan University.
9. Contractor must bid the project to meet the schedule outlined in the bid documents which may include weekend and/or shift work. Contractor must staff the project accordingly to meet the schedule since the end date is firm. Rowan will not entertain change orders for contractor's inability to meet this schedule or time extensions.
10. Contractor is responsible to schedule and manage all required inspections, including but not limited to Final Certificate of Occupancy inspection.
11. Contractor is required to maintain a clean job site and to turn over the building back to the owner in the condition it was received.
12. Contractor is responsible to perform final cleaning prior to Final Turn Over and Owner's Final Acceptance.

### 1.4 CONTRACT

- A. Project will be constructed under a single prime general construction contract.

### 1.5 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 48-division format and CSI/CSC's "MasterFormat" numbering system.
  1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.

### 1.5 USE OF PREMISES

- A. General Construction Operations: Contractor shall have limited use of premises for construction operations, including a limited use of the project site (outside the facilities exterior walls) during the period of construction activity. Contractor's use of the premises is limited by Rowan's right to perform work or to retain other contractor's on portions of the Project or to limit access for events or other functions as the University might require. The Contractor will be given notice of any such events well in advance so that arrangements can be made to insure the prosecution of the work continues as scheduled.
- B. Arrange use of site and premises to allow:
  1. Owner occupancy.
  2. Work by others.
  3. Work by Owner.
- C. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond the building perimeter unless prior approval of the University is received prior to conduction such work or operations.

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1. Limit site disturbance, as approved by Rowan University.
  2. **REFER TO SECTION 011400 FOR WORK HOURS.**
  3. Storage of construction materials and equipment is not permitted inside the existing building.
  4. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Rowan University, Rowans employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    - a. Schedule deliveries to minimize use of the driveways and entrances.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- D. Use of Existing Building: Maintain existing building in a weather tight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.
- E. **The Contractor will be responsible for photographing the entire area of work, adjacent spaces where incidental work may occur, corridors and elevators accessing the area of work, the loading area, and contractor parking area. The Contractor will provide the Owner with digital copies of all the photographs prior to mobilization as a record of the existing conditions PRIOR to the start of the work.** Digital format will be in PDF format.

### 1.6 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 48-division format and CSI/CSC's "MasterFormat" numbering system.
1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.

### 1.7 MISCELLANEOUS PROVISIONS

- A. **WORK REQUIRED TO BE PERFORMED UNDER THIS CONTRACT SHALL BE COMPLETED IN ACCORDANCE WITH THE FOLLOWING MILESTONES AND COMPLETION DATES. CONTRACTORS MUST INCLUDE IN THEIR BIDS ALL COSTS INCLUDING OVERTIME ASSOCIATED WITH INSURING THAT THE PROJECT IS COMPLETED BY THE MILESTONE DEADLINES LISTED HEREIN.**

Summary of Milestones:

1. Notice to Proceed/Authorization anticipated by **June 1, 2024**. The University intends to issue Notice to Proceed, Construction Contract, and/or University purchase order as evidence of contract award.
2. ALL submittals to Architect 30 days after of notice to proceed. Long lead items to be submitted first.
3. **Substantial Completion by October 15, 2024. This includes completed final inspections and Owner's beneficial use of space.**
4. Final Completion of work on site by **November 15, 2024**. All construction punch list work, closeout documentation, final payment application, etc. will be completed by this date.

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B. The contractor is required for submitting and obtaining all required permits from the NJ Department of Transportation for RT 322 if deems necessary to the project.

C. Weather Conditions:

1. Unfavorable weather conditions shall not be justification for delays in completion or final completion dates as specified. No change orders will be issued or approved for extensions of time due to weather conditions. Seasonal weather conditions shall be considered in the planning and scheduling of all work influenced by high or low ambient temperatures for the completion of all contract work within the allotted contract time. In addition, appropriate allowances shall be made for anticipated time losses due to normal rain and snow conditions by statistically expanding the estimated time durations for weather sensitive activities with the constraint that the substantial completion deadline cannot change.
2. The University may at its sole discretion entertain extensions of time from the contractor for weather related delays. However no extensions of time shall be considered by the University until at least twenty-five (25) lost project schedule days have accrued. Lost time will accrue on a proportionate basis – 1/4 lost day will be charged as 1/4 lost day, 1/2 lost day will be charged as 1/2 lost day, and so forth. A lost project schedule day is considered a day or any portion of a day when all members of the construction workforce on the project cannot work due to inclement weather conditions. Whether or not the contractors' workforce fails to begin work or leaves the project site on any given day due to a claim of inclement weather a lost project schedule day will not be recognized by the University until it is approved in writing by the Owner's Project Manager.
3. Should the University approve an extension of time the contractor may only submit reimbursement for the cost of the extension of rental equipment agreements; bond premium and insurance adjustments at actual cost with no mark up; and general conditions directly impacted by the approved extension. Appropriate back up documentation as requested by the Owner's Project Manager must accompany any submission for reimbursement. Appropriate back up can be anything from copies of contractor's rental agreements showing rental durations, unit costs, rental rates, etc. to copies of superintendents pay stubs.

D. Intent of Contract: The drawings and specifications of the contract are intended to require the contractor to provide for everything reasonably necessary to accomplish the proper and complete finishing of the work. All work and materials included in the specifications and not shown on the drawings, or shown on the drawings and not in the specifications, shall be performed and/or furnished by the contractor as if described in both. Any incidental materials and/or work not specified in the drawings and/or the specifications which are, nevertheless, necessary for the true development thereof and reasonably inferable therefrom, the contractor shall understand the same to be implied and required, and shall perform all such work and furnish all such materials as if particularly delineated or described therein. Should there be an obvious error between the drawings and specifications, the most stringent constraints of the conflicting information shall be assumed by the contractor and it shall be the contractor's responsibility to complete the work as reasonably required, consistent with the intent of such drawings and specifications as may be interpreted by the University.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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END OF SECTION 011000

### CONTRACTOR RESPONSIBILITY CHART

MATERIAL	PROVIDED BY	INSTALLED BY	LOW-VOLTAGE WIRING BY	BACKBOX & CONDUIT BY	PROGRAMMING/HEAD END TERMINATIONS/TESTING BY
DATA AND TELEPHONE JACKS, CAT6 CABLING, FIBER OPTIC CABLE, FACEPLATES, RACKS AND PATCH PANELS	●	●	●	●	●
TELEPHONES	☐	☐	—	●	☐
CARD ACCESS	☐	●	●	●	☐
SECURITY CCTV CAMERS, NVR, SWITCHES, ECT.	☐	●	●	●	☐
DOOR HARDWARE (LATCH RETRACTION, STRIKES, POWER SUPPLIES, ECT.)	●	●	●	●	☐
AUDIO VISUAL SYSTEMS (PROJECTORS, MOUNTS, PROJECTION SCREENS, DISPLAY MOUNTS, ECT.)	☐	●	●	●	☐
POWER & LIGHTING	●	●	●	●	●
FIRE ALARM	●	●	●	●	●
WIFI & WIRELESS ACCESS POINTS	☐	●	●	●	☐
LEGEND					
ROWAN UNIVERSITY	☐				
GENERAL CONTRACTOR	●				

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### SECTION 011400 – WORK RESTRICTIONS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 USE OF PREMISES

- A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
  - 1. Limits: Confine construction operations to weekdays (Monday through Friday) from 7:00 AM to 5:00 PM. Weekend and Holiday work may be permitted if approved by the Owner.
  - 2. Owner Occupancy: Allow for Owner occupancy of building, site and use by the public.
  - 3. Driveways and Entrances: Keep streets, driveways and entrances serving premises clear and available to owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Use of Existing Building: Repair damage caused by construction operations. Protect building and its occupants during construction period.

##### 1.3 OCCUPANCY REQUIREMENTS

- A. Full Owner Occupancy: Owner will occupy site and existing building during entire construction period. Cooperate with owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations.

##### 1.4 WORK SEQUENCE

- A. Work shall be completed within the schedule as outlined in Section 011000 – Summary. University intends to issue Notice to Proceed, Construction Contract, and/or University Purchase Order as evidence of contract award on or before Project start date listed.

##### 1.5 CONTRACTOR WORK AREAS, WORKING CONDITIONS AND EQUIPMENT STORAGE REGULATIONS

- A. The Contractor shall not unreasonably encumber the facilities with its equipment or work to be performed. Work conducted by the Contractor, Subcontractor, or any other person and/or firm affiliated with the Contractor shall be contained within pre-designated working areas established by the documents.

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- B. The Contractor shall, at all times during the progress of the work, keep the site free from the accumulation of all rubbish and debris caused by its performance. The Contractor shall remove all debris and rubbish related to its work at the end of each workday to the satisfaction of the Owner's Project Manager. Tool storage boxes shall not be permitted inside the building on the first floor or outside the building.
- C. The Contractor shall adequately secure and protect its equipment, materials and vehicles. The University assumes no liability for any damage to, or theft of, the Contractor's property. The Contractor shall have the use of a designated area for storage and staging of construction materials and equipment. The Contractor shall be responsible for adhering to security procedures outlined by the Owner's Project Manager.
- D. The Contractor is responsible for all safety precautions for all of its employees and property while performing its services.
- E. The Contractor shall strictly limit its employees' use of the facilities for lunch, smoking or rest time usage to only those areas designated by the Owner's Project Manager. Use of facility telephones will not be allowed. Use of building toilet facilities shall not be permitted. Smoking is not allowed inside the building.

### 1.6 WORK STOPPAGES, EXISTING UTILITY INTERRUPTIONS, NOISE AND ODOR RESTRICTIONS, AND MATERIAL APPROVALS

- A. Work Stoppages – DOES NOT APPLY.
- B. Existing Utility Interruptions: 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 Owner not less than five (5) working days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Owner's Project Manager's written permission.
- C. Consideration shall be given by the Contractor regarding odors emanating from adhesives and sealants, etc and excessive noise. If the odors or noise are such that they may disturb the employees and guests, then such work shall be performed while the building is not occupied. This determination shall be at the sole discretion of the Owner's Project Manager. The playing of radios and other unnecessary noise will not be permitted at any time.
- D. All material safety data sheets shall be submitted and approved by the Owner's Project Manager prior to use of the material.
- E. The playing of radios and other unnecessary noise will not be permitted at any time.

### 1.7 PROTECTION OF INTERIOR FINISHES

- A. The Contractor shall take extra care to avoid damage or soiling to any part of the facility. The Contractor is responsible for all damages or destruction caused directly or indirectly by its performance to any part of the building or adjoining property. Any damage or destruction caused by the Contractor or its employees will be repaired or replaced as the Owner's Project Manager directs and to their satisfaction with all costs charged to the Contractor. The costs may be deducted from any and all amounts due to the Contractor.



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- B. Any of the Contractor's employees found defacing, damaging or marring the building or its finishes or contents shall be immediately removed by the Contractor. The Contractor shall be charged for all remedial work to restore the damaged area or contents to their original condition to the satisfaction of the State.
  
- C. The Contractor shall take all necessary steps to ensure adequate protection of all building furniture, equipment and building finishes, including but not limited to: floors, walls, ceilings, windows, draperies, blinds, carpeting, doors, doorways and contents. In this endeavor, all workers are to take precautions to protect rugs and floors. The Contractor shall be charged for all remedial work to clean, repair and/or replace items damaged by the Contractor to the satisfaction of the State.
  
- D. The Contractor is responsible for the cost of cleanup of dust, dirt and stains caused by the work to the satisfaction of the Owner's Project Manager. The Contractor shall take all necessary precautions to keep dust, dirt and debris to a minimum both within the construction area and throughout the buildings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011400

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### SECTION 012400 – PROCEDURES AND CONTROLS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, General Conduct of the Work and Special Requirements, Supplementary Conditions, and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 DESCRIPTION OF WORK

- A. The types of minimum requirements for procedures and performance or control work of a general nature, to be fulfilled collectively by contractors, include but are not necessarily limited to the following categories:

1. Coordination and meetings.
2. Administration/supervisory personnel.
3. Examination and checking of contract drawings.
4. Surveys and records or reports.
5. Limitations for use of site.
6. Protection of Persons and Property.
7. Special reports.
8. Subcontractor, material approval.
9. Tradesmen and workmanship standards.
10. Inspections, tests and reports.
11. Progress photographs.
12. General installation provisions.
13. Control Wiring.
14. Chases, recesses and openings.
15. Sleeves, built-in items.
16. Cutting and patching.
17. Uncovering and correction of work.
18. Cleaning and protection.
19. Conservation and salvage.

##### 1.3 COORDINATION AND MEETINGS

- A. General: Contractor shall prepare a written memorandum of general instructions on required coordination activities including notices/reports/meetings, and distribute memorandum to each engaged entity performing work at project site, with copies to Architect and Owner.
- B. Coordination Drawings: Where work by separate entities requires off-site fabrication of products and materials which must be accurately interfaced and closely intermeshed to produce required results, prepare coordination drawings to indicate how work shown by separate shop drawings will be interfaced, intermeshed, and sequenced for installation.
  1. Comply with submittal requirements of "Submittals" section, and other requirements outlined in the other Divisions.
- C. Biweekly Job Meeting: The Contractor's Project Manager and Superintendent, the Owner's

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Project Manager and the Architect shall attend biweekly job meetings convened by the Owner for the purpose of affording the opportunity to review Contractor's coordination efforts, to expedite the performance of administrative tasks, and to generally assess the work progress. Contractor shall require representation (at each meeting) by every entity currently involved in coordination or planning for the work (of the entire project). Contractor shall participate in meetings in a manner, which will resolve coordination problems.

1. Time and location of job meetings shall be designated by the mutual agreement of the Contractor, Architect and Owner.
2. Job meetings shall be chaired by the Architect, who shall record the proceedings in the form of minutes and shall be responsible for proper distribution thereof to all parties. Initial minutes will be distributed within three (3) business days after the meeting.
3. Any and all corrections or clarifications to these minutes shall be received by the Architect in writing within three (3) days of their issuance. After the interval allowed for corrections and clarifications, Job Meeting Minutes will stand as part of the project record.
4. All decisions, instructions and interpretations given by Owner, with concurrence of the Architect, at these meetings shall be binding and conclusive on Contractor.
5. Architect and Owner shall have the right to schedule Special Job Meetings or increase the frequency of job meetings if, in his opinion, the progress and condition of the work warrant it. Attendance at such meetings is mandatory.
6. Subcontractors and suppliers shall attend at the request of the Architect or Owner as appropriate to the agenda topics at each meeting.
7. Agenda:
  - a. Review of Work progress.
  - b. Field observations, problems, and decisions.
  - c. Identification of problems, which impede planned progress.
  - d. Maintenance of Progress Schedule- updated by Contractor and discussed at every meeting.
  - e. Corrective measures to regain projected schedule milestones and deadlines.
  - f. Planned progress during succeeding work period and two (2) week look ahead.
  - g. Effect of proposed changes on progress schedule and coordination.
  - h. Review and update Submittal Log for every meeting.
  - i. Other business relating to the Work.

D. Pre-Construction Meeting: Owner will schedule a meeting after Notice of Award.

1. Attendance Required:
  - a. Owner.
  - b. Architect.
  - c. Contractor.
2. Agenda:
  - a. Execution of Owner/Contractor Agreement.
  - b. Submission of executed bonds and insurance certificates.
  - c. Distribution of Contract Documents.
  - d. Submission of list of Subcontractors, list of Products, schedule of values, etc.
  - e. Procedures and processing of field decisions, submittals, substitutions, applications for payment, proposal requests, Change Orders, and Contract closeout procedures.

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- f. Scheduling (Preliminary Progress Schedule by Contractor).
  - 3. The above Agenda is a comprehensive list of items that could be discussed at the Pre- Construction Meeting. Some items will be included while the Owner may choose to handle other items by other means.
  - 4. Architect will record minutes and distribute copies within two (2) days after meeting to participants, with two copies to Contractor, Owner, and those affected by any decisions made.
- E. Pre-Installation Conferences:
- 1. When required by individual specification sections, contractor shall convene a pre-installation conference prior to the start of installation for the portion of work in question.
  - 2. Require attendance of all Subcontractors, suppliers, manufacturers (if necessary), Owner Architect (at the Owners request), Engineers (at the Owners request) directly affecting or affected by the Work in question.
- F. Application for Payment "PENCIL COPY" review meeting:
- 1. Contractor to schedule a Pencil Copy Review Meeting five (5) working days prior to payment period deadline stipulated in the Agreement.
  - 2. Contractor will be responsible to incorporate all agreed upon changes to the Pencil Copy version of the Application and submit the revised Application in accordance with all Contract requirements.

### 1.4 ADMINISTRATIVE/SUPERVISORY PERSONNEL

- A. General: In addition to a Home Office Project Manager and a Field Construction Superintendent and other administrative and supervisory personnel required for performance of the work, the Contractor shall provide specific coordinating personnel as may be required for proper interface between the trades and other work of the total project.
- B. Project Superintendent: The Contractor shall provide a full-time Project Superintendent, who is experienced in administration and supervision of building construction of a type similar in nature and scope to this Project, including mechanical and electrical work, and who is hereby authorized to act as the general coordinator of interfaces between the work of all the trades. For purpose of this provision, "interface" is defined to include the scheduling and sequencing of work, sharing of access to work spaces, installations, each trade's protection of work by other trades, cutting and patching, tolerances, preparation of coordination drawings, inspections, tests, and temporary facilities and services.
- C. Submittal of Staff Names, Duties: Within 15 days of contract date, the Contractor shall submit to the Owner and Architect a listing of Contractor's principal staff assignments and consultants, naming persons and listing their addresses, telephone numbers and past construction experience.

### 1.5 EXAMINATION AND CHECKING OF CONTRACT DOCUMENTS

- A. Contractor shall be responsible for reviewing the contract documents in accordance with the requirements specified herein.
  - 1. Contractor shall examine and check all quantities and dimensions given on contract drawings, and shall be responsible for noting any errors which can be discovered by

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such examination and check, and shall be responsible for satisfactory joining and fitting of all parts of the work; any check or observation by Architect/Engineer shall not relieve the Contractor of any responsibility as to correctness of the work.

2. Field verification of dimensions on drawings is specifically directed and required of the Contractor as a matter of course, because locations, distances and elevations will be governed by actual field conditions. Contractor shall review plans, site plans and details of construction on the drawings, and adjust his work to conform to all conditions indicated thereon or reasonably inferable therefrom.
3. Discrepancies shown on different plans and details, or between drawings, and actual field conditions, or between drawings and specifications, shall promptly be brought to the attention of the Architect for interpretation and resolution.
4. If, in Contractor's opinion, any work is indicated on drawings or specified in such a manner as will make it impossible to produce such in conformance with the contract, he shall refer same to Architect for interpretation. If additional and supplementary instructions are necessary, Architect/Engineer will prepare and issue same in an appropriate form to the Contractor, with a copy being forwarded to the Owner.
5. Contractor is directed never to scale dimensions or locations from contract drawings. Consult Architect/Engineer for dimensions and locations of all items.

### 1.6 SURVEYS AND RECORDS/REPORTS

- A. General: Working from lines and levels established by property survey, and as shown in relation to the work, the Contractor shall establish and maintain bench marks and other dependable markers to set lines and levels for the work at each story of construction and elsewhere on site as needed to properly locate each element of entire project. Contractor shall calculate and measure required dimensions as shown (within recognized tolerances if not otherwise indicated); and shall not scale drawings to determine dimensions. Advise tradesmen performing the work, of marked lines and levels provided for their use in layout of work.

### 1.7 LIMITATIONS FOR USE OF SITE

- A. General: It is the intent of the Owner to preserve the present character of the campus to the greatest extent possible, both during and after the period of construction. To this end the Contractor will be subject to certain operational controls in the movement of personnel and equipment on and off the construction site. The Contractor's cooperation with the general goal of protecting and preserving the Institute campus, and with the specific controls specified hereinafter, shall be mandatory. The following general controls shall be observed:
  1. Construction activities, including location of temporary support facilities, stockpiling of materials, loading and unloading, parking for construction personnel and other related activities shall be restricted to areas as specified by the Owner.
  2. The accumulation or stockpiling of debris, rubbish or other material resulting from demolition or construction operations will not be permitted. Removal and off-site disposal must proceed concurrent with demolition and construction activities, to the end that the site shall at all times present a neat, orderly and workmanship appearance. No liquid or solid material of any kind is to be disposed of on campus property. No burning of trash or debris will be permitted on the site.
  3. The Contractor shall be responsible for the prevention, abatement and control of any environmental pollution arising from demolition or construction activities in the performance of the work, in full compliance with all applicable Federal and State laws and regulations.
    - a. Existing trees and other vegetation on and adjacent to the project site shall be

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protected. Refer to Section 015000 - "Temporary Facilities" - for specific requirements concerning fencing. Under no circumstances shall materials be stored or heavy equipment operated beneath the drip lines of existing trees.

4. Contractor shall be responsible for the control of dust arising from demolition or construction operations within the project site or along the Access Routes.
- B. Allocation of Space: In addition to site utilization limitations and requirements shown on drawings, and indicated by other contract documents, Contractor shall administer allocation of available space equitably among separate subcontractors and other entities needing access and space, so as to produce overall efficiency in performance of total work of project.
- C. Deliveries: Contractor shall schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.
- D. Construction Access:
  1. Contractor shall plan, coordinate and execute all construction activities in such manner as to avoid traffic disruption over local streets.
    - a. Prior to the start of work, Contractor shall contact the Police Department and determine approved travel routes for delivery vehicles on local streets.
    - b. Contractor shall obtain and pay for all necessary permits in connection with the operation of overweight and over length vehicles on City streets.
  2. Contractor shall be responsible for controlling all traffic entering and leaving the Owner's property including provision of flagmen as necessary. Contractor shall be responsible to require mud removal from rubber-tired vehicles departing the immediate project site. Operation of tracked vehicles shall be restricted to the project site as defined by the contract limit lines, and is not permitted on paved areas.
  3. Whenever and wherever the project work must be performed outside the contract limit lines, and after the necessary permits have been secured from local authorities, Contractor shall erect and maintain barricades, danger signals and warning signs at working sites, closed roads, intersections and other places of danger to traffic, the work, or the public. Barricades and obstructions of any kind shall be marked with lights or flares at not more than five (5) foot intervals visible for a distance of not less than 500 feet. Contractor shall provide sufficient watchmen and traffic directors and shall take all necessary precautions for the proper protection of the work and the safety of the public.
  4. Contractor shall be responsible for identification, control and maintenance of construction traffic within the contract limit lines. Identification and control shall include the provision of temporary traffic signs and the installation of barricades and warning lights to protect the work and to identify excavations or other hazards, all as may be required. Maintenance shall include the provision and placing of ballast materials as may be required, grading and compaction, removal of debris, removal of snow, and general care to insure a serviceable roadbed at all times.
    - a. The Owner shall be responsible for snow removal from paved roadways and parking lots in the vicinity of the project area, but not within the work areas or areas immediate to the Contractor's temporary facilities.
  5. Prior to final completion, perform all cleaning and repairs as necessary to restore all existing areas within the limits of any and all work required as a part of the scope of these contract documents, to their original condition.

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- E. Temporary Parking for Construction Personnel: The Owner shall designate available areas for parking.
  - 1. Offsite parking will be available for employee parking, in an area to be designated by the Owner on RUI property. Construction personnel will not be permitted to park in campus parking lots, except as specifically designated and authorized by the Owner. The designated parking area may change due to seasonal demands of the Owner.
  
- F. Staging and Storage Area: The Contractor shall have the authority and responsibility to plan and locate storage areas, equipment marshaling areas, and temporary field facilities. Staging and storage areas shall be so located and utilized as to afford unrestricted access to all of the work at all times. Such areas shall not encroach upon access routes to the work, nor shall they be so located or utilized as to impede free access of emergency vehicles. Such areas must be approved by the Owner prior to use by the contractor.
  - 1. Staging and storage areas shall be located wholly within the contract limit lines and site enclosure fence.
  - 2. All loading and unloading operations shall occur inside the contract limit lines and behind the site enclosure fence.
  - 3. Storage of materials and equipment outside the site enclosure fence or on City streets is absolutely prohibited.
  - 4. Prior to final completion, perform all cleanup, disposal, grading, topsoiling, seeding and other work as necessary to restore the entire staging/storage area to its original condition.
  
- G. Verification of Underground Utilities: Contractor shall have the responsibility to verify the actual locations of existing underground utility lines. Should verified underground utility locations conflict with excavation required in connection with the work, Contractor shall notify the Owner's Project Manager immediately. Hand excavation shall be required at locations in close proximity to verified existing utilities.
  - 1. The Owner does not guarantee the accuracy and completeness of information shown on any contract drawings for underground utilities; Contractor must be responsible for ascertaining all facts concerning utility locations.
  - 2. Damage to existing underground utilities, caused as a result of Contractor's negligence or failure to comply with the requirements listed herein, shall be repaired and/or replaced at Contractor's expense, to the complete satisfaction of the Owner and utility company by close of business of the day of damage.
  
- H. Cleaning and Trash Disposal: Comply with requirements specified in Section 01500, "Temporary Facilities".

### 1.8 PROTECTION OF PERSONS AND PROPERTY

- A. Safety Precautions and Programs: Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. He shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent, unless otherwise designated by the Contractor, in writing, to the Owner.
  
- B. Protection of Persons: Contractor shall take all necessary precautions for the safety of employees on the work, and shall comply with all applicable provisions of Federal and State safety laws, union safety regulations, and building codes to prevent accidents or injury to persons on, about or adjacent to the premises where the work is being performed. Particular

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attention is called to the requirements of the Federal Occupational Safety and Health Act (OSHA). In connection with the work of its own forces, Contractor shall direct and properly maintain, at all times, as required by the conditions and progress of the work, all necessary safeguards for the protection of workers and the public and shall post danger signs warning against the hazards created by such features of construction as protruding nails, hoists, well holes, elevator hatchways, scaffolding, window openings, stairways and falling materials.

1. Security/protection provisions are specified in "Temporary Facilities" section.
- C. Protection of Work and Property: Contractor shall take all precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury or loss to:
  1. All the work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of his Subcontractors, or Sub-subcontractors; and
  2. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.
    - a. Refer to "Temporary Facilities" section for specific requirements concerning fencing around existing trees.
- D. Emergencies: In any emergency affecting the safety of persons or property, Contractor shall act with diligence, at his discretion, to prevent threatening injury, damage or loss. In such case, he shall immediately notify the Owner, of the action taken and shall forthwith prepare and submit a detailed and documented report to the Owner and the Architect.
- E. Insurance and Indemnification: Comply with requirements of the Contract Agreement.

### 1.9 SPECIAL REPORTS

- A. General: Except as otherwise indicated, submit special reports directly to Owner within one day of occurrence requiring special report, with copy to Architect/Engineer and others affected by occurrence.
- B. Reporting Unusual Events: When an event of unusual and significant nature occurs at site, the Contractor shall prepare and submit a special report listing chain of events, persons participating, response by Contractor's personnel, evaluations of results or effects, and similar pertinent information. When such events are known or predictable in advance, it is the responsibility of the Contractor to advise the Owner in advance at earliest possible date.
- C. Reporting Accidents: Contractor shall prepare and submit reports of significant accidents, at site and anywhere else work is in progress. Record and document data and actions; comply with industry standards. For this purpose, a significant accident is defined to include events where bodily injury is sustained, or property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury.

### 1.10 SUBCONTRACTOR, MATERIAL APPROVAL

- A. Material Approval: Contractor shall submit to the Owner and Architect, for approval, a list of all vendors and manufacturers for the supply of materials and equipment, whether specified or not, starting within fifteen (15) calendar days after award of contract; said list shall be complete within forty-five (45) days thereafter. In instances where specified materials and equipment are subject to the Owner's and Architect's approval by way of the submittal



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process, no contract shall be entered into with any vendor, supplier or manufacturer before the Owner and Architect have approved his name in writing.

- B. Subcontractor Approval: Contractor shall, beginning within fifteen (15) calendar days after award of contract and ending within forty-five (45) days thereafter, notify the Architect and Owner in writing of the names of all subcontractors proposed for the work, and shall not employ any without prior written approval of the Owner, or any that Owner may within a reasonable time reject.

### 1.11 TRADESMEN AND WORKMANSHIP STANDARDS

- A. General: Contractor shall instigate and maintain procedures to ensure that tradesmen performing work at site are skilled and knowledgeable in methods and craftsmanship needed to produce required quality-levels for workmanship in completed work. Remove and replace work, which does not comply with workmanship standards as specified and as recognized in the construction industry for applications indicated. Remove and replace other work damaged or deteriorated by faulty workmanship or its replacement.
- B. Availability of Tradesmen: At each progress or job meeting, Contractor shall review availability of tradesmen and projected needs to accomplish work as scheduled. Require each entity employing tradesmen to report on current and pending trade actions and jurisdictional matters, which might affect progress of work. Where possible dispute or delay is identified, consider alternatives and take actions to avoid disputes and delays.
- C. Labor Peace Clause:
  - 1. The Contractor agrees that in the performance of the work called for under these Contract Documents, it will employ only such labor as will not delay or interfere with the speedy and diligent progress of the project and as will be acceptable to and work in harmony with all other workmen employed by the Owner.
  - 2. In the event of labor difficulties (including, but not limited to, strikes, walkouts, picketing, boycotts, shutdowns, or inability to obtain a sufficient number of competent laborers or mechanics), which interfere with the work, or any part thereof, it shall be the responsibility of the contractor to take all measures necessary and possible to insure the projects progress and completion as prescribed by the time schedule including, but not limited to, seeking injunctive relief in an appropriate Court of Common Pleas, filing an unfair labor practices charge(s) with the National Labor Relations Board, discharging employees who engage in an unprotected strike or work stoppage, or any other applicable legal or equitable action related to the aforesaid labor difficulty which occurs in connection with the performance of this contract.
  - 3. In the event of a strike or stoppage of work resulting from a dispute involving or affecting the labor employed by the contractor (including subcontractors and suppliers), the Owner may, at its option, terminate this contract. However, where practicable the contractor will give subcontractors 24 hours to resolve the strike or stoppage of work before terminating its contract. In the event there is a conflict between this clause and any other agreement between contractor and the Owner, including but not limited to other provisions of this contract, other written agreements and verbal agreements, this clause will take precedent. In the event of such termination, the Owner shall have the right to take possession, for the purpose of completing such work, of all materials, tools, and appliances on its premises and employ any person or persons to finish the work and provide the materials and labor for such work. The Contractor shall not be entitled to receive any further payments under this agreement until the work shall be finished completely, at which time the contractor shall be paid whatever balance is found to be due to contractor for amounts

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expended by it either for labor, materials, or otherwise, plus contractor's percentage of profit as provided in this agreement, less, however such expenses or damages as the Owner may suffer by so completing the work. The Contractor shall not be entitled to prospective profits on portions of the project not performed by it or with respect to the materials not furnished by it. Further, it is understood and agreed that should the expenses to the Owner in completing the contract be increased by reason of such discontinuance of the services of this contractor, then this contractor shall be responsible to the Owner for such entire increase in addition to the other expenses or damages referred to above.

### 1.12 INSPECTIONS, TESTS AND REPORTS

- A. General: Required inspection and testing services are intended to assist in determination of probable compliances of the work with requirements, but do not relieve Contractor of responsibility for those compliances, or for general fulfillment of requirements of contract documents. Specified inspections and tests are not intended to limit Contractor's quality control program. Afford reasonable access to agencies performing tests and inspections.
- B. Inspection and Testing by Independent Agencies: General requirements are specified in "Quality Control Services" section of these specifications (Section 01400). Particular requirements are specified in the technical sections (Divisions 02 through 48).
- C. Inspection and Testing by Authorities with Jurisdiction: If the Contract Documents, laws, ordinances, rules, regulations or order of any public authority having jurisdiction require any portion of the Work to be inspected, tested or approved, the Contractor shall give the Owner not less than five (5) working days notice in writing of its readiness for inspections or testing. The Contractor shall bear all costs of such inspections, tests or approvals conducted by public authorities.
- D. Inspection and Testing by Contractors: When inspections and tests are required by the technical sections of these specifications to be performed by Contractors on installed materials and equipment, all such inspections and tests shall be conducted in the presence of, and upon timely notice to, the Owner, and the results thereof approved prior to acceptance of the installation. Fuel, power and any other items or services required for the proper inspecting and testing of equipment and for the period of instructing the Owner's operating personnel shall be at the cost and expense of the Contractor furnishing such equipment.
- E. Special Inspection and Testing: If the Owner or Architect/Engineer determines that any Work requires special inspection, testing or approval, not otherwise required herein, he will instruct the Contractor to order such special inspection, testing or approval, and the Contractor shall give notice as provided in subparagraph C. If such special testing or inspection reveals a failure of the Work to comply with the requirements of the Contract Documents, the Contractor shall bear all costs thereof, including compensation for the Architect/Engineer's additional services made necessary by such failure; otherwise the Owner shall bear all costs and an appropriate Change Order will be issued.

### 1.13 PROGRESS PHOTOGRAPHS

- A. Refer to Specification Section 01300, "Submittals" for requirements pertaining to Progress Photographs.
- B. Provide photographs of the site and construction throughout progress of Work produced by an experienced photographer or job superintendent experienced in taking construction

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photographs, acceptable to the Owner.

- C. Take photos in a timely fashion to allow for their submission with each application for a payment and/ as follows (as applicable):
1. Installation of site utilities.
  2. Installation of footings.
  3. Installation of foundations.
  4. Building pad proof roll.
  5. Building pad sub grade (vapor barrier and stone).
  6. Installation of concrete floors, decks, walls, etc.
  7. Installation of masonry for stair towers, elevator, exterior walls, etc.
  8. Installation of structural steel, steel deck and joist, etc.
  9. Rough grading.
  10. Installation of parking lot paving, parking lot lighting, line stripping, etc.
  11. Installation of interior and exterior framing.
  12. Plumbing and electrical rough-ins.
  13. HVAC ductwork and units.
  14. Installation of telecommunications cabling and devices.
  15. Installation of roofing.
  16. Installation of windows, doors, hardware, etc.
  17. Enclosure of walls and ceilings.
  18. Interior and exterior finishes.
  19. Installations of millwork, casework, trim work, etc.
  20. Landscaping
  21. Final Completion.
- D. Digital PDFs: Color photos. 4" X 8" or larger of each view. Provide enough photos at each stage of construction to give someone not familiar with the Project a clear understanding of the progress of the work. Review photos with the Owner's representative at each stage of construction requiring photographs. The Owner will determine if additional photos will be needed.
1. PDF format.
  2. Identify each print. Identify name of Project, orientation of view, date and time of view.
- E. Deliver prints with each Application for Payment or at times specified by Owner with transmittal letter.

### 1.14 MANAGEMENT SOFTWARE

- A. The Contractor is to purchase and implement a web-based project management software solution for use by the Architect, Consultants, Construction Manager, and Owner. The Contractor shall utilize this software solution throughout the project duration for all related project documentation including, but not limited to Requests for Information, submittals, daily reports, correspondence, meeting minutes, change orders, etc.

### 1.15 REQUESTS FOR INFORMATION

- A. The Contractor is to prepare and submit a Request for Information (RFI) through web-based project management tool for action when a clarification and/or additional information is required to perform an activity of work.

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- B. The request must include a drawing and/or specification reference when applicable and must also include a proposed solution for review by the Architect. Requests not provided with a recommended solution, if applicable, will be returned to the Contractor with no action until such recommendation is provided.
- C. The Construction Manager and Architect will endeavor to respond to requests in a timely manner so not to impact onsite activity. It is the Contractor's responsibility to review the Contract Documents thoroughly for planned work and submit a request with sufficient time for the Construction Manager and Architect to review and respond. If the Contractor fails to carry out this responsibility, The Contractor will not be entitled to an extension of time and/or additional incurred costs should the request impact construction progress.

### PART 2 - PRODUCTS (NOT APPLICABLE)

### PART 3 - EXECUTION

#### 3.1 GENERAL INSTALLATION PROVISIONS

- A. Pre-Installation Conference: Well in advance of installation of every major unit of work which requires coordination and interfacing with other work, Contractor shall meet at project site with subcontractors, installers and representatives of manufacturers and fabricators who are involved in or affected by unit of work, and in its coordination or integration with other work which has preceded or will follow. Contractor shall advise Owner and Architect of scheduled meeting dates. At each meeting review progress of other work and preparations for particular work under consideration, including requirements of contract documents, options, related change orders, purchases, deliveries, shop drawings, product data, quality control samples, possible conflicts, compatibility problems, time schedules, weather limitations, temporary facilities, space and access limitations, structural limitations, governing regulations, safety, inspection and testing requirements, required performance results, recording requirements, and protection. Contractor shall record significant discussions of each conference, and agreements and disagreements, along with final plan of action. Distribute record of meeting promptly to everyone concerned, including Architect/Engineer and Owner.
  - 1. Do not proceed with the work if associated pre-installation conference cannot be concluded successfully. Instigate actions to resolve impediments to performance of the work and reconvene conference at earliest date feasible.
- B. Installer's Inspection of Conditions: Require Installer of each major unit of work to inspect substrate to receive the work, and conditions under which the work will be performed, and to report (in writing to Contractor) unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
- C. Manufacturer's Instructions: Where installations include manufactured products, comply with manufacturer's applicable instructions and recommendations for installation, to whatever extent these are more explicit or more stringent than applicable requirements indicated in contract documents.
- D. Inspect each item of materials or equipment immediately prior to installation and reject damaged and defective items.
- E. Provide attachment and connection devices and methods for securing work properly as it is

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installed; true to line and level, and within recognized industry tolerances if not otherwise indicated. Allow for expansions and building movements. Provide uniform joint widths in exposed work, organized for best possible visual effect. Refer questionable visual-effect choices to Architect for final decision.

- F. Recheck measurements and dimensions of the work, as an integral step of starting each installation.
  - G. Install work during conditions of temperature, humidity, exposure, forecasted weather, and status of project completion, which will ensure best possible results for each unit of work, in coordination with entire work. Isolate each unit of work from non-compatible work, as required to prevent deterioration.
  - H. Coordinate enclosure (closing-in) of work with inspections and tests, so as to minimize necessity of uncovering work for that purpose.
  - I. Mounting Heights: Except as otherwise indicated, mount individual units of work at industry-recognized standard mounting heights, for applications indicated. Refer questionable mounting height choices to Architect/Engineer for final decision.
- 3.2. The contractor shall include in his/her proposal the cost of all control wiring and its installation for all mechanical equipment including, but not limited to, heating, ventilating and air conditioning systems, ATC systems, boilers, remote monitoring systems, etc. which systems require electrical control wiring. The contractor shall employ a sub-contractor approved by the University for all such control wiring. The sub-contractor shall provide a final certificate of electrical inspection of the control wiring. Installed or control wiring must connect to a point of electrical power supply as shown on the contract documents.

### 3.3 CHASES, RECESSES AND OPENINGS

- A. Contractor shall build chases, recesses, openings, channels and flues, and shall leave or create holes where shown on drawings, or where directed for piping, electrical conduits, switchboxes, panelboards, flues and ducts, or any other feature of the mechanical and electrical work. All trades requiring chases, recesses, openings, etc. shall furnish to the Contractor, complete detailed drawings for all chases, recesses and openings required in connection with such work in ample time to allow the construction to proceed without interruption or delay. Comply with requirements of "Submittals" section of these specifications.
  - 1. Contractor shall close, build in and finish around or over all chases, recesses, openings, etc. after installation of mechanical and electrical work has been completed. Should any fail to furnish the above required information in time, he shall, at his own expense, arrange for all cutting, rebuilding, patching and finishing, but shall employ the Contractor whose work must be cut to do so.
  - 2. Contractor shall obtain prior written approval from the Architect/Engineer and the Owner before cutting or boring through beams, floor construction or supporting members.

### 3.4 SLEEVES, BUILT-IN ITEMS

- A. Each trade shall be responsible for furnishing and setting of sleeves, built-in items, anchors, inserts, etc. for his work. Contractor shall build these items into the construction.
  - 1. Comply with requirements of "Submittals" section in the preparation of sleeve

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drawings.

### 3.5 CUTTING AND PATCHING

- A. General: Do not cut-and-patch structural work in a manner resulting in reduction of load-carrying capacity or load/deflection ratio; submit proposed cutting and patching to Architect/Engineer for structural approval before proceeding. Do not cut-and-patch operational elements and safety-related components in a manner resulting in reduction of capacities to perform in manner intended or resulting in decreased operational-life, increased maintenance, or decreased safety. Do not cut-and-patch work which is exposed on exterior or exposed in occupied spaces of building, in a manner resulting in reduction of visual qualities or resulting in substantial evidence of cut-and-patch work, both as judged solely by Architect. Remove and replace work judged by Architect to be cut-and-patched in a visually unsatisfactory manner.
1. Contractor shall do all cutting, fitting, adjusting and patching as may be required to permit the several parts to properly come together as intended and indicated.
  2. Engage original Fabricator/Installer to perform cutting-and-patching of structural work, operational/ safety-related components, and visually exposed work; or, if not available, engage only recognized experts; employ only proven methods.
  3. Do not cut or alter work performed under separate contracts without the Architect's written permission.
  4. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specific requirements and methods needed for proper performance of the work of this Section.
  5. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
  6. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
  7. Examine and verify specific conditions described in individual specification sections.
  8. Verify that utility services are available, of the correct characteristics, and in the correct locations.
  9. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.
- B. Materials: Except as otherwise indicated or approved by Architect/Engineer, provide materials for cutting-and-patching which will result in equal-or-better work than work being cut-and-patched, in terms of performance characteristics and including visual effect where applicable. Use materials identical with original materials where feasible and where recognized that satisfactory results can be produced thereby.
- C. Temporary Support and Protection: Provide adequate temporary support for work to be cut, to prevent failure. Do not endanger other work. Provide adequate protection of other work during cutting-and-patching, to prevent damage; and provide protection of the work from adverse weather exposure.
- D. Cut work using methods least likely to damage work to be retained and work adjoining.
1. Where physical cutting action is required, cut work with sawing and grinding tools, not with hammering and chopping tools. Core drill openings through concrete work. Comply with the requirements of applicable sections of Division 02 where cutting-and-patching requires excavating and backfilling.

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2. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
  3. At penetrations of fire rated walls, partitions, ceilings, or floor construction, completely seal voids with fire rated materials in accordance with Section 07841 to full thickness of the penetrated elements.
  4. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
- E. Patch with seams, which are durable and as invisible as possible. Comply with specified tolerances for the work.
1. Where feasible, inspect and test patched areas to demonstrate integrity of work.
- F. Restore exposed finishes of patched areas; and, where necessary extend finish restoration onto retained work adjoining, in a manner, which will eliminate evidence of patching.
1. Where patch occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing patch, after patched area has received prime and base coats.
- G. Execute cutting and patching including excavation and fill to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide opening in the work for penetrations of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.
- H. Execute work by methods to avoid damage to other work, and which will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original conditions.
- I. **ALL CUTTING AND PATCHING SHALL BE CONSIDERED PART OF THE BASE BID PRICE WHEN THE WORK IS REQUIRED AS PART OF THE OVERALL PROJECT. NO ADDITIONAL PAYMENT WILL BE CONSIDERED FOR WORK OF THIS SECTION UNLESS ALL APPLICABLE PARTIES OBTAIN PRIOR AUTHORIZATION OR WRITTEN APPROVAL.**

### 3.6 UNCOVERING AND CORRECTION OF WORK

- A. Comply with requirements of the General Conditions of the Contract, and with additional requirements specified herein.
1. Subsequent Disclosure of Faulty Work: Failure of Owner or Architect/Engineer to exercise powers of rejection or condemnation against the work of the Contractor during construction shall not be construed as an acceptance on Owner's part or Architect/ Engineer's part that Contractor's work has been faithfully performed, if the fact be otherwise.

### 3.7 PROJECT CONDITIONS

- A. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

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- C. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and air from discharge of noxious, toxic substances, and pollutants produced by construction activities. Comply with all governmental and code requirements.

### 3.8 PREPERATION FOR CUTTING AND PATCHING AND/OR NEW WORK.

- A. Prepare surfaces and remove surface finishes to provide for proper installation of work and finishes.
- B. Clean substrate surfaces prior to applying next material or substance.
- C. Seal cracks or openings of substrate prior to applying next material or substance.
- D. Apply manufacturers required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

### 3.9 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Owner's Representative and Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect/Engineer and Owner's Representative the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Utilize recognized engineering survey practices.
- F. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
  - 1. Site improvements including but not limited to pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations, etc.
  - 2. Building foundation, column locations, all floor elevations, stairwells, elevator shafts, machine and mechanical rooms, etc.
  - 3. All other work as necessary to complete all the requirements of the contract documents.
- G. Periodically verify layouts by same means.
- H. Maintain a complete and accurate log of control and survey work as it progresses.

### 3.10 GENERAL INSTALLATION REQUIREMENTS

- A. Install Products as specified in individual sections and in accordance with manufacturer's recommendations.
- B. Make neat transitions. Patch work to match adjacent work in texture and appearance. Where new Work abuts or aligns with existing, perform a smooth and even transition.
- C. When existing finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and



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make recommendations to the Architect and Owner.

### 3.11 CLEANING AND PROTECTION

- A. General: During handling and installation of work at project site, Contractor shall clean and protect work in progress and adjoining work on a basis of perpetual maintenance. Apply suitable protective covering on newly installed work where reasonably required to ensure freedom from damage or deterioration at time of substantial completion; otherwise, clean and perform maintenance on newly installed work as frequently as necessary through remainder of construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- B. Removal of all debris and rubbish resulting from or relating to the construction work; rubbish shall not be thrown from building openings above the ground floor unless confined within chutes.
  - 1. Progress Cleaning:
    - a. Maintain areas free of waste material, debris, and rubbish (on a daily basis). Maintain site in a clean and orderly condition, as determined by the Owner.
    - b. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
    - c. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
    - d. Collect and remove waste materials, debris, and rubbish from site periodically and dispose of off-site.
    - e. Protect installed work and provide special protection where specified in individual specification sections.
    - f. Provide temporary and removable protection for installed Products. Control activity during and after installation in the immediate work area to prevent damage.
    - g. Protect finished floors and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials appropriate for the task involved.
- C. Limiting Exposures of Work: To extent possible through reasonable control and protection methods, Contractor shall supervise performance of work in a manner and by means which will ensure that none of the work, whether completed or in progress, will be subjected to harmful, dangerous, damaging, or otherwise deleterious exposures during construction period. Such exposures include (where applicable, but not by way of limitation) static loading, dynamic loading, internal pressures, external pressures, high or low temperatures, thermal shock, high or low humidity, air contamination or pollution, water, ice, solvents, chemicals, light, radiation, puncture, abrasion, heavy traffic, soiling, bacteria, insect infestation, combustion, electrical current, high speed operation, improper lubrication, unusual wear, misuse, incompatible interface, destructive testing, misalignment, excessive weathering, unprotected storage, improper shipping/handling, theft and vandalism.
- D. Construction Debris: The Contractor shall intermittently remove waste and rubble so that at no time shall there be undue accumulations. Upon completion, the Contractor shall dress up all areas affected by this work whether inside or outside the boundary of the Project. Loading, crating, hauling and dumping will be at the contractor's expense.
- E. Rubbish: The Contractor shall provide covered metal trash cans in sufficient quantity to accept the accumulation of rubbish and garbage from lunch and the like of employees of all

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Contractors working on site.

1. The Contractor shall instruct his and his subcontractors' employees to deposit their trash and garbage in these containers and not elsewhere about the site; and also not to use the containers for construction scraps, rubbish, trash and surplus materials.
2. The Contractor shall empty these containers daily and haul the rubbish to a legal disposal site off the property.

F. Roads and Pathways:

1. The Contractor is responsible for the removal of construction dirt and debris in public areas on the site and in the surrounding areas serving the site.
2. Dirt and mud tracked onto streets by the Contractor or its subcontractors is to be immediately cleaned up by the Contractor to the satisfaction of the Owner and the local municipal authorities.

G. Trucks: All trucks leaving the construction area are to be covered in accordance with NJDOT over the road requirements. Trucks leaving the site are to be clean and free of mud or other materials.

H. Quality Assurance: University streets and pathways are to be maintained in a clean safe condition at all times. Under no circumstances shall the Contractor leave the site each day without inspecting and verifying that streets and paths to the construction site, access areas, lay down areas, and gates in the area of the site are clean of all construction related materials and are clean and safe for use by the Rowan University population. The Contractor will immediately correct any violation of this provision upon notification by the Owner.

### 3.12 CONSERVATION AND SALVAGE

A. General: It is a general procedural requirement for Contractor's supervision and administration of the work that construction operations be carried out with maximum practical consideration for conservation of energy, water and materials; and with maximum practical consideration for salvaging materials and equipment involved in performance of the work but not incorporated therein.

END OF SECTION 012400

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### SECTION 012500 - CONTRACT MODIFICATION PROCEDURES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
  - 1. Division 01 Section "Allowances" for procedural requirements for handling and processing allowances.
  - 2. Division 01 Section "Unit Prices" for administrative requirements for using unit prices.
  - 3. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

##### 1.3 MINOR CHANGES IN THE WORK

- A. Architect may issue through Owner's Project Manager supplemental instructions authorizing Changes in the Work, not involving adjustment to the Contract Time, as "Architects Supplemental Instructions" (ASI). Architects Supplemental Instructions may or may not involve adjustments to the contract sum. **THERE WILL BE NO ADJUSTMENTS TO THE CONTRACT TIME ALLOWED FOR THIS PROJECT.**
  - 1. For ASI's involving no adjustment to the contract sum or time, the contractor is authorized to execute the change or clarification immediately.
  - 2. For ASI's resulting in an adjustment to the contract sum, do not consider them instructions either to stop work in progress or to execute the proposed change without obtaining written authorization from the Owner. Written authorization can include the provisions of the general conditions, Article 14, paragraphs 14.5.3 and 14.7.1, an approved change order or a Construction Change Directive.
- B. The technical specifications may refer to certain brand name products by name/or catalog number. This is done to establish standards of quality. Is it not being done to intentionally eliminate competition. If the contractor deems a product equivalent or better quality from another supplier or manufacture where fully suitable in design and manufacturing, see Section 016350 Substitution Procedures.

##### 1.4 PROPOSAL REQUESTS

- A. In the event the Contractor believes that any change directed by the Owner or Architect would entitle it to additional compensation to complete its work under this contract, **the Contractor shall immediately notify the Owner's Project Manager of this fact WITHIN 48 HOURS OF RECEIPT OF THE CHANGE REQUESTED.** The contractor shall then

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prepare and submit an original of the Change Order Request (COR) with all supporting documentation to the Owner's Project Manager and submit two (2) copies of the Change Order Request (COR) with all supporting documentation to the Architect and University within five (5) calendar days of its receipt of the directive by the Owner and/or Architect.

- B. Owner-Initiated Proposal Requests (OIPR): Owner may issue proposal requests or may have the Architect issue such requests. In any event a detailed description of proposed changes in the Work will be submitted to the contractor that may require adjustment to the Contract Sum. THERE WILL BE NO ADJUSTMENTS TO TIME FOR ANY GIVEN CHANGE ORDER REQUESTED. If necessary, the description will include supplemental or revised Drawings and Specifications.
1. OIPR issued by Architect are for information only. For ASI's resulting in adjustments to the contract sum, do not consider them instructions either to stop work in progress or to execute the proposed change without first obtaining written authorization from the Owner.
  2. If the contractor feels the ASI or OIPR requires a change to the contract sum then the contractor shall notify the Owner's Project Manager of this fact within 48 hours of receipt of the ASI or OIPR directive.
  3. Within five (5) business days after receipt of directive, ASI or OIPR from the Owner, submit a Change Order Request (COR) estimating cost adjustments to the Contract Sum necessary to execute the change. The contractor shall then prepare and submit an original of the COR with all supporting documentation to the Owner's Project Manager and submit two (2) copies of the COR with all supporting documentation to the architect.
    - 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 delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor directly attributable to the change.
      - 1) Labor shall be broken down by man-hours, hourly wages, fringe benefits per hour and any other benefits payable.
    - d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float however the date of Substantial and Final Completion cannot be extended.
- C. In the event that the Contractor encounters a condition that it considers a change, the Contractor shall immediately notify the Owner's Project Manager prior to disturbing the condition and shall then prepare and submit an original of the COR with all supporting documentation to the Owner's Project Manager and two (2) copies of a Change Order Request with all required supporting documentation to the architect within five (5) calendar days of encountering the condition. The condition shall not be disturbed until the Owner's Project Manager has inspected the condition.
- D. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a Change Order Request (COR) to Owner's Project Manager. The contractor shall prepare and submit one (1) original of the COR with all supporting documentation to the Owner's Project Manager and submit two (2) copies of the COR with all supporting documentation to the architect.

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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.
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 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 Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float however the date of Substantial and Final Completion cannot be extended.

E. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

### 1.5 ALLOWANCES (IF APPLICABLE ON A GIVEN PROJECT)

A. Allowance Adjustment: To adjust allowance amounts, base each Allowance Request Proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins. **Only allowances included as part of the Bid Price will be considered for an Allowance Authorization. All other Proposals must be hard costed.**

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

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within ten (10) business days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. Owner will reject claims submitted later than ten (10) business days after such authorization.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower- priced materials or systems of the same scope and nature as originally indicated.

C. ***Use the same procedure(s) followed for handling Change Order Requests (COR's) and Change Orders with Allowances (except use Allowance Forms rather than Change Order Forms).***

### 1.6 CHANGE ORDER PROCEDURES

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- A. Upon the Owner's approval of a Change Order Request (COR), the Owner will direct the Architect to issue a Change Order for signatures of the Contractor and Owner on AIA Document G701.
1. The Change Order breakdown shall be in sufficient detail to permit an analysis of all material, labor, equipment, sub-contract and overhead costs as well as profit. Any amount proposed for sub-contracts shall be supported by a similar price breakdown.
- B. Each Change Order must contain a detailed description of the change and the amount by which the Contract Price will be increased or decreased.
- C. COMPUTATION OF ADDITIONAL COMPENSATION
1. In connection with any request for additional compensation the Contractor shall furnish a price breakdown, as follows:
    - a. Labor shall be broken down by the man-hour, hourly wages, fringe benefits per hour and any other benefits payable by the Contractor;
    - b. Materials shall be broken down by quantity and unit prices.
  2. Unless otherwise directed, the breakdown shall cover all work involved in the change whether such work was deleted, added or changed.
  3. The breakdown shall be in sufficient detail to permit an analysis of all material, labor, equipment, sub-contract and overhead costs as well as profit. Any amount proposed for sub-contracts shall be supported by a similar price breakdown.
  4. The following rates shall apply in computing indirect costs and profit for the negotiation of additional compensation under all provisions of this contract, which provide for such adjustments that do not exceed twenty-five thousand dollars (\$25,000.00). The resulting change in the contract amount will include the indirect impact cost of extended performance computed in accordance with the terms of this article and no further consideration of such costs arising from the specific modification will be given. The percentages for overhead and profit shall be negotiated and may vary according to the nature, extent and complexity of the work involved. If not negotiated prior to the start of construction then the rates herein designated shall apply. The percentages shall be applicable for deleted work as well as additional work. When a change consists of both added and deleted work, the applicable percentages shall be applied to the net cost or credit. In any event, the percentages shall not exceed the sum of the following:
    - a. Overhead will be the sum of ten percent (10%) of direct labor costs.
      - 1) For the purpose of the article, the term direct labor shall include all labor by contractor's employees necessary to perform the actual work on site. Foremen, equipment operators and skilled, semi-skilled and common laborers directly assigned to the specific operation are direct labor; project managers, superintendents, office personnel, and subcontractors are not direct labor.
      - 2) The term direct labor costs shall consist of the contract or actual payroll rate of wage per hour and fringe benefits paid for each and every hour that such employees are actually engaged in the performance of the work. Overhead will be the sum of ten percent (10) % of direct material costs.
    - b. Overhead will be the sum of ten percent (10%) of direct material costs.

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- 1) For the purpose of the article, the term direct material costs shall consist of the actual costs of the materials, including applicable tax and transportation charges
  - c. For rented equipment, an hourly rental rate will be used which will be determined by using the monthly rental rates taken from the current edition of the rental rate blue book for construction equipment and dividing it by one hundred seventy-six (176). An allowance will be made for operating costs for each and every hour the equipment is actually operating in accordance with the rate listed in the aforesaid rental book. The contractor will be allowed only sixty-five percent (65%) of the rental rate on contractor owned equipment.
  - d. Bond premiums, insurance, payroll taxes and travel subsistence, if applicable, will be allowed at actual cost (only) for the equitable adjustment allowed. No mark-up will be allowed for overhead on these indirect cost items.
  - e. The contractor's profit on the sub-contractor's work will be five percent (5%) of the sub-contractor's costs. Sub-contractor indirect costs will be computed in the same manner as for the contractor. The contractor agrees to incorporate this article in each of its sub-contracts.
  - f. A profit of six percent (6%) where profit is allowable by the terms of the applicable contract provision shall be added to the contractor's total cost for the equitable adjustment allowed for the work conducted by the contractor's own workforce. Indirect costs will not be duplicated in direct costs.
  - g. When more than one (1) tier of sub-contractors exists, they shall be treated as one (1) sub-contractor for the purpose of mark-ups.
- D. ANY CONTRACTOR PERFORMING CHANGE ORDER WORK WITHOUT **WRITTEN** APPROVAL FROM THE OWNER DOES SO AT ITS OWN RISK.
1. Only the signature of an Assistant Vice President or above is authorized to give approval of a Change Order Request (COR) or Change Order (CO). The Owner's Project Manager is not authorized to approve change orders. The Owner's Project Manager is only authorized to verify the work in question is in addition to or outside the scope of work delineated on the original contract documents.

### 1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect at the direction of the Owner's Project Manager may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum.
- 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 adjustments to the Contract.

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PERFORMANCE OF CHANGE ORDER WORK

- A. A contractor who performs any scope of work associated with a change order or allowance (if allowances are applicable on a given project) without receiving proper approval in accordance with all contract document requirements hereof does so at its own risk. The Contractor shall have waived any and all claims for additional compensation related to said changes or conditions encountered.

END OF SECTION 012500



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### SECTION 012900 - PAYMENT PROCEDURES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
  - 1. Division 01 Section "Allowances" for procedural requirements governing handling and processing of allowances.
  - 2. Division 01 Section "Unit Prices" for administrative requirements governing use of unit prices.
  - 3. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 4. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

##### 1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

##### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
  - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with Continuation Sheets
    - b. Submittals Schedule.
  - 2. Submit the Schedule of Values submission to Architect and Owners Construction Manager in accordance with the general conditions and general conduct of work.
  - 3. Sub schedules: Where the Work is separated into phases requiring separately phased payments, provide sub schedules showing values correlated with each phase of

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payment.

- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the Schedule of Values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Architect's project number.
    - d. Contractor's name and address.
    - e. Date of submittal.
  2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
    - a. Related Specification Section or Division.
    - b. Description of the Work.
    - c. Name of subcontractor.
    - d. Name of manufacturer or fabricator.
    - e. Name of supplier.
    - f. Change Orders (numbers) that affect value.
    - g. Dollar values
    - h. Cost totals.
      - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
  3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
    - a. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed.
  4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
  5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    - a. Differentiate between items stored on-site and items stored off-site.
    - b. The University may, in its sole discretion, pay the Contractor for material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the contractor at locations other than the site may also be taken into consideration if (1) such consideration is specifically authorized by the contract and (2) the contractor furnishes a form entitled "Contractor's Summary of Stored Materials" and agreement and bill of sale certification, respectively, for stored materials and (3) the contractor furnishes evidence of insurance for said materials or a bonded warehousing agreement.

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6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities. Allowances will only be accepted for items listed in the Bid Documents.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
  - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place must be shown as separate line items in the Schedule of Values.
9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.
  - a. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.

### 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
  1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
  2. Submit three (3) copies of each Application for Payment, at least five (5) business days prior to the actual submission date as specified. This Application will be reviewed and adjusted by all parties (Architect, Owner and Contractor) at a “**PENCIL COPY REVIEW**” meeting prior to final approval.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: The date for each progress payment is per the General Conditions. The period covered by each Application for Payment starts on the day following the end of the preceding period and ends 15 days before the date for each progress payment.
- D. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Owner’s Project Manager will return incomplete applications without action.
  1. Entries shall match data on the Schedule of Values and Contractor's Construction

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- Schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- F. Transmittal: Submit 3 (three) signed and notarized original copies of each Application for Payment to Owner's Project Manager by a method ensuring receipt within 24 hours. All copy's shall include 'Attachment to G702- Certification for Payment", Release of Liens Forms (included in the Contract Documents) entirely completed for the contractor, all subcontractors and anyone else whose payment is listed in the Schedule of Values for the application being requested, AIA G706 A-Contractors Affidavit..., Certified Payrolls and Monthly Work Force Reports, updated and current Construction Schedule, updated and current Submittal Log, and current Project Photograph's.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Release of Mechanic's Lien: With each Application for Payment, submit partial or final releases of mechanic's lien (as may apply) from every entity that is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
  2. When an application shows completion of an item, submit final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Submit final Application for Payment with or proceeded by final waivers from every entity involved with performance of the Work covered by the application that is lawfully entitled to a lien.
  5. Release Forms: Submit release of lien on forms, executed in a manner acceptable to Owner. (Use Form listed in Division 0 of the Specifications).
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of Values.
  3. Contractor's Construction Schedule (preliminary if not final).
    - a) A final schedule must be submitted prior to Owners payment of the second (2<sup>nd</sup>) progress payment.
  4. Products list.
  5. Schedule of unit prices.
  6. Submittals Schedule (preliminary if not final).
  7. List of Contractor's staff assignments.
  8. List of Contractor's principal consultants.
  9. Copies of building permits.
  10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  11. Initial progress report.
  12. Report of preconstruction conference.
  13. Certificates of insurance and insurance policies.
  14. Performance and payment bonds.

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15. Data needed to acquire Owner's insurance.
  16. Initial settlement survey and damage report if required.
  17. Current construction photographs as specified herein.
- I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
  5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
  6. AIA Document G707, "Consent of Surety to Final Payment."
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  9. Final, liquidated damages settlement statement.
- K. When Owner or Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Provide one (1) copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.
1. Any other information or documentation required by other provisions of the contract documents shall be supplied.
- L. In order to be proper an Application for Payment must include the following as applicable:
1. Total amount, payee name and address, department/agency, payee declaration, payee reference number and identification number.
  2. contract number, contractor's name, period of the Application, completion date, number of sheets, amount due this period, amount to date, retainage, certification by payee, certification signed by the Project Manager and Architect and approval of payment signed by the contracting officer or his/her designee, previous payment requests, total deductions and additions.
  3. In making progress payments for work, the University will retain ten percent (10%) of the approved invoice of payment until final acceptance and completion of all work covered by the contract.
  4. After fifty percent (50%) of the work has been completed, upon written request by the contractor and provided the contracting officer determines that the contractor's performance and progress have been satisfactory, the University will make partial payments thereafter in full of the approved payment amount. If, however, progress is

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not maintained in accordance with the approved schedule, the contracting officer may elect to reinstitute retainage of ten percent (10%) of amounts due to the contractor. The contracting officer shall have the sole authority to determine whether contractor's performance and progress warrant waiver of ten percent (10%) retainage.

- M. Upon acceptance and completion of each building or other clearly definable severable portion of the contract work for which the price is stated separately within the contract, payment may be made in full at the discretion of the contracting officer including retained percentages thereon less authorized deductions.
- N. All authorized Applications are to be sent to the Owners authorized representative at the address provided at the pre-construction conference. Receipt shall start the prompt payment clock unless returned to the contractor for correction within thirty (30) calendar days after receipt. Reference section 10.2.4 (d) of the General Conditions.

### 1.6 FINAL PAYMENT

- A. Upon final acceptance, the amount due the contractor under this contract shall be paid upon satisfactory completion by the contractor of all contract close-out requirements as required by the University, completion of a University audit on all contract values and payments and after the contractor shall have furnished the University with a final release of liens from the contractor and all subcontractors, sub-subcontractors, vendors, suppliers and any other entity affiliated with the contractor for completion of this project of any and all claims against the University arising by virtue of this contract other than claims in stated amounts as may be specifically excepted by the contractor from the release.
- B. Upon satisfying the above conditions, the contractor shall submit a properly executed Application for Final Payment to the University through the Owner's Project Manager. The University Controller shall date stamp the Application. This action by the University Controller shall constitute receipt of a properly executed State invoice application.
- C. If, for any reason, the contractor refuses final payment, the project shall be closed-out by the University unilaterally processing a final acceptance certificate. The University will hold all residual funds in escrow until all claims of the University and all contractors are satisfied.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012900

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### SECTION 013100 – COORDINATION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, General Conduct of the Work and Special Requirements, Supplementary Conditions, and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 SUMMARY

- A. This Section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:
  - 1. General project coordination procedures.
  - 2. Conservation.
  - 3. Coordination Drawings.
  - 4. Administrative and supervisory personnel.
  - 5. Cleaning and protection.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 01 Section "Field Engineering" specifies procedures for field engineering services, including establishment of benchmarks and control points.
  - 2. Division 01 Section "Submittals" for preparing and submitting the Contractor's Construction Schedule.
  - 3. Division 01 Section "Contract Closeout" for coordinating contract closeout.

##### 1.3 COORDINATION

- A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
  - 3. Make provisions to accommodate items scheduled for later installation.
- B. The mechanical, electrical and fire protection drawings are diagrammatic only and are not intended to show the alignment, physical locations or configurations of such work. Such work shall be coordinated by the Contractor and shall be installed to clear all obstructions, permit proper clearances for the work of other trades, satisfy all code requirements and present an orderly appearance where exposed at no additional cost to the Owner.

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- C. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
  - 1. Prepare similar memoranda for the Owner and separate contractors where coordination of their work is required.
  
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Prepare and coordinate scheduling, delivery and processing of submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
  - 2. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
  - 3. Coordinate space requirements, supports, and installation of mechanical and electrical work, which are indicated diagrammatically on the Drawings. Follow routing shown for pipes, ducts and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.
  - 4. Installation and removal of temporary facilities.
  - 5. Progress meetings.
  - 6. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
  - 7. Coordinate completion and clean-up of work of separate sections.
  - 8. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.
  - 9. Project closeout activities.
  
- E. Conservation: Coordinate construction operations to assure that operations are carried out with consideration given to conservation of energy, water, and materials.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work.

### 1.4 SUBMITTALS

- A. Coordination Drawings: Prepare coordination drawings where careful coordination is needed for installation of products and materials fabricated by separate entities. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.
  - 1. Show the relationship of components shown on separate Shop Drawings.
  - 2. Indicate required installation sequences.
  - 3. Comply with requirements contained in Section "Submittals."
    - a. Note the coordination drawing submittal requirements under Section 013300



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"Submittals", paragraph 2.3.9

- B. Staff Names: Within fifteen (15) days of commencement of construction operations, submit a list of the Contractor's principal staff assignments, including the superintendent and other personnel in attendance at the Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers.
  - 1. Post copies of the list in the Project meeting room, and the temporary field office.

### PART 2 - PRODUCTS (NOT USED)

### PART 3 - EXECUTION

#### 3.1 GENERAL COORDINATION PROVISIONS

- A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

#### 3.2 CLEANING AND PROTECTION

- A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at Substantial Completion.
- B. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.
- C. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

END OF SECTION 013100

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### SECTION 013200 – CONSTRUCTION PROGRESS SCHEDULE

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions (Contract Administration Division Section D), General Conduct of the Work and Special Requirements, and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 SUBMITTALS

- A. Within three (3) days after the date established in the Notice to Proceed, University Contract and/or purchase order submit preliminary schedule indicating the scope of work for the duration of the project. A Gantt chart format will be acceptable however the final approved schedule must be in both a Gantt chart and CPM schedule format. If another method other than CPM is used the critical path and float time must be established and programmed into the schedule.
- B. Initial Working CPM Schedule Submittal: To the extent necessary for the Contractor to reflect in the arrow diagram the plan for completion of this contract, the contractor shall meet with and furnish all necessary information for the preparation of the scheduling system within ten (10) calendar days after award of this contract. This information shall include, but not necessarily be limited to, logical sequencing of work operations; activity time estimated, intended crew flow, activity costs and estimated manpower requirements of each activity.
  - 1. The contractor shall be responsible to reflect all sub-contractor work as well as his/her own work in proper coordinated sequence on the network diagram. The contractor shall be prepared to meet as many times as necessary with the Owner's Project Manager for the timely development of the project schedule.

##### 1.3 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number. At a minimum provide the following.
  - 1. Include a separate bar for each portion of work or operation.
  - 2. Identify the first workday of each week.
  - 3. Identify each critical path task or portion of work.
  - 4. Identify task durations, predecessors and dependent tasks.
  - 5. Identify milestone dates for completion/start of each critical path element.
- B. The contractor shall utilize the earliest scheduled start and finish dates in planning, coordinating and performing the work under this contract including all activities of sub-contractors, equipment vendors and suppliers.

#### PART 2 - PRODUCTS – NOT USED

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### PART 2 - PRODUCTS (NOT USED)

### PART 3 - EXECUTION

#### 3.1 CONTENT

- A. Construction logic and activity time durations shall be established by the contractor subject to approval by the Owner's Project Manager consistent with contract requirements and reflective of proper coordination between trades.
- B. The Owner's Project Manager shall establish the specific level of detail to be reflected in the scheduling system.
- C. Seasonal weather conditions shall be considered in the planning and scheduling of all work influenced by high or low ambient temperatures for the completion of all contract work within the allotted contract time. In addition, appropriate allowances shall be made for anticipated time losses due to normal rain and snow conditions by statistically expanding the estimated time durations for weather sensitive activities with the constraint that the substantial completion deadline cannot change.
- D. The coordinated combined Progress Schedule the Contractor will develop shall incorporate the schedules of all Prime Contractors engaged on the project. The Schedule shall be in a form as specified herein and elsewhere in the contract documents and in sufficient detail to satisfy the Architect/Engineer and the University.
- E. The Progress Schedule based upon the Contractor's logic and time estimates shall indicate, in suitable detail for display, all significant features of the Work of each Contractor, including the placing of orders and anticipated delivery dates for critical items and all other critical path activities, submissions and approvals of Shop Drawings, all work activities to be performed by each Contractor and the beginning and time durations thereof, float time and the dates of substantial and final completion of the various branches of the Work.
  - 1. Show complete sequence of construction activity, with dates for beginning and completion of each element of construction.
  - 2. Identify each item by specification section number or per bid form breakdown.
  - 3. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
  - 4. Indicate delivery dates as milestones for Owner-furnished items and any critical path items.
  - 5. Provide legend for symbols and abbreviations used.
  - 6. Show critical path tasks; differentiate them from other construction tasks.
  - 7. Schedule will be based upon a five-day workweek.

#### 3.2 REVIEW AND EVALUATION OF SCHEDULE

- A. Review and Approval of Initial Working Schedule: Within ten (10) calendar days after receipt of the initial arrow diagram and computer produced schedule, the University's representative shall meet with the contractor and for joint review, correction or adjustment of the proposed plan and schedule to evaluate the cost values assigned to each activity. Within ten (10)

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calendar days after the joint review, the Contractor will revise the arrow diagram and the computer- produced schedule in accordance with agreement reached during the joint review and shall submit two (2) copies each of the revised arrow diagram, computer produced schedule and cost requisition to the University. The resubmission will be reviewed by the University and, if found to be as previously agreed upon, will be approved. An approved copy of each will be returned to the Contractor. The contractor shall review the schedule to insure that it reflects all changes agreed to and, if all changes have been made, the contractor shall approve and sign the network diagrams, computer produced schedule and cost requisition listing at that time. Approval will be without reservation and the contractor will be deemed to have accepted the schedule as adequate, proper and binding in all respects and shall not raise objections to the schedule. After the network diagrams, computer-produced schedule and cost requisition listing have been signed, the Contractor shall forward one (1) set of signed copies of all scheduling documents to the Owner's Project Manager. The arrow diagram and the computer-produced schedule with approved signatures shall constitute the project work schedule until subsequently revised in accordance with the requirements of this section.

- B. Evaluate project status to determine work behind schedule and work ahead of schedule. Submit revised recovery schedule with action plan to bring "behind schedule" tasks and milestones back into original timeline.

### 3.3 UPDATING SCHEDULES

- A. Maintain schedules to record actual start and finish dates of completed activities.
  - 1. Updated schedules must be submitted at each progress meeting and with each application for payment or as required by Architect or Owner. These schedules must include the following:
    - a. approved changes in activity sequencing;
    - b. changes in activity durations for unstarted or partially completed activities where agreed upon;
    - c. the effect to the network of any delays in any activities in progress and/or the impact of known delays, which are expected to affect future work;
    - d. the effect of contractor modifications; i.e., activity durations, logic and cost estimates; to the network;
    - e. changes to activity logic where agreed upon to reflect revision in the contractor's work plan; i.e., changes in activity duration, cost estimates and activity sequences for the purpose of regaining lost time or improving progress;
    - f. changes to milestones, and due dates (except substantial completion) which have been agreed upon by the University since the last revision of the schedule.
- B. At the same time the network is updated, the contractor and the University's representative shall jointly make entries on the preceding network diagram schedule to show actual progress, to identify those activities started by date and those completed by date during the previous period to show the estimated time required to complete each activity started but not yet completed, to show activity percent completed and to reflect any changes in the arrow diagram approved in accordance with the preceding paragraph. After completion of the joint review and the University's approval of all entries, the Contractor will submit updated network diagrams and an updated computer produced calendar dated schedule to the University and the contractor.

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1. The resultant computer print-out and network diagrams shall be recognized by the contractor as solely his/her updated construction schedule to complete all remaining contractor work except that portion affected by interim University decisions.

### 3.4 DISTRIBUTION OF SCHEDULES

- A. Upon approval at each level of schedule development (preliminary, final for Contractors work and Single Coordinated including all Prime Contractors work) the Contractor shall prepare and distribute (10) copies of the schedule at each level to the University. The Contractor shall also prepare and distribute two (2) copies of the final schedule showing Prime Contractors work to each Prime Contractor. In the event a new Prime Contractor is added to the job the General Construction Contractor shall furnish a revised schedule immediately with copies as indicated. The final coordinated schedule shall be signed and dated by all Prime Contractors involved and shall become part of the contract documents.
- B. Distribute copies of updated (current) schedules to Contractors project site file, subcontractors, suppliers, Architect and Owner at each bi-weekly progress meeting. Also submit an updated (current) schedule with each Application for Payment or more often as required by the Architect and/or Owner.

### 3.5 SCHEDULE ADJUSTMENTS

- A. Upon Owner and/or Architects request, if Contractor falls behind the approved schedule, the Contractor must submit a revised schedule to show how the Contractor intends to accomplish the completion of the work within the original contract time.
  1. Within seven (7) days after receipt of notice from the Owner, the contractor shall submit to the University in writing an explanation of corrective action taken or proposed. The contracting officer shall make a decision binding on all parties after reviewing the written submissions.
- B. Responsibility for Completion: The contractor agrees that whenever it becomes apparent from the current monthly computer produced calendar dated schedule that any contract completion date will not be met, he/she will take some or all of the following actions at no additional cost to the University.
  1. increase construction manpower in such trades and numbers as will substantially eliminate the backlog of work in the opinion of the Construction Manager and contracting officer
  2. increase the number of working hours per shift, shifts per working days, working days per week or the amount of construction equipment of any combination of the foregoing sufficiently to substantially eliminate the backlog of work in the judgment of the Construction Manager and contracting officer
  3. reschedule activities to achieve maximum practical concurrence of accomplishment of activities
- C. Lost time due to weather conditions will not accrue nor be credited to Contractor for weather delays with time added to the Substantial Completion milestone deadline. No weather delays will be granted once the building is under roof.

### 3.6 BI-WEEKLY REPORTING

- A. Upon request from the Owner, the Contractor shall furnish for approval, his proposed

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operating schedule for the next immediate two-week period of time. This schedule will be submitted at each bi-weekly progress meeting along with the overall updated schedule.

1. Every two (2) weeks, the Architect will conduct a coordination and scheduling meeting on the job site. At this meeting, the contractor shall provide detailed information in the form of a bar chart schedule regarding the work schedule to be performed during the upcoming two (2) weeks. Bi-weekly scheduling by the contractor shall be in accordance with the priorities and degree of concurrent work required by the official schedule for the project. The contractor shall be prepared to explain a difference between the contractor's bi-weekly schedules and the priorities required by the latest updating of the official schedule.
2. At the bi-weekly scheduling meeting, the Owner and Architect shall review the bar charts for the preceding two (2) weeks and the contractor shall report the progress actually achieved for each activity, which was scheduled to be performed during the two (2) weeks, including the actual dates on which the work was performed. The contractor agrees that this information shall constitute the official historical record of project progress. At each bi-weekly scheduling meeting, the contractor shall document any current delays to work operations. In addition, the contractor shall provide any available information regarding any potential delays, which they anticipate; i.e., procurement delays, expected strikes, etc.
3. Following the bi-weekly scheduling meeting, the Contractor shall issue to the Owner and Architect a new set of bi-weekly bar charts as developed at the meeting, which shall constitute the construction schedule for the upcoming two (2) weeks. The Contractor shall also issue a narrative bi-weekly progress analysis documenting progress achieved during the preceding two (2) weeks and analyze delays reported to constitute current or anticipated impacts to timely construction. The revised bar chart schedule and progress narrative shall agree with the meeting minutes and items discussed and agreed to at the bi-weekly meeting.
4. The contractor shall be represented at the bi-weekly scheduling meeting by their Construction Manager who shall have complete authority to provide the information required for the development of the next two (2) weeks bar chart schedule, documentation of past progress and documentation of delays. The contractor representatives shall also be authorized to discuss correction action planned to overcome delaying conditions at these meetings.

### 3.7 DAILY REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at the Project site:
  1. List of subcontractors at Project site.
  2. List of separate contractors at Project site.
  3. Approximate count of personnel at Project site.
  4. Equipment at Project site.
  5. Material deliveries.
  6. High and low temperatures and general weather conditions.
  7. Accidents.
  8. Meetings and significant decisions.
  9. Unusual events (refer to special reports).
  10. Stoppages, delays, shortages, and losses.
  11. Meter readings and similar recordings.
  12. Emergency procedures.
  13. Orders and requests of authorities having jurisdiction.

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14. Change Orders received and implemented.
  15. Construction Change Directives received and implemented.
  16. Services connected and disconnected.
  17. Equipment or system tests and startups.
  18. Partial Completions and occupancies.
  19. Substantial Completions authorized.
- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents prepare and submit a detailed report. Submit with requests for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

END OF SECTION 013200

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### SECTION 013300 SUBMITTAL PROCEDURES

#### PART 1 - PRODUCTS

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, General Conduct of the Work, Supplementary Conditions, and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 SUMMARY

- A. This Section augments requirements set forth in the General Conditions and specifies administrative and procedural requirements for submittals required for performance of the Work, including:
  - 1. Contractor's Use of Architect's CAD Files.
  - 2. Shop Drawings.
  - 3. Product Data.
  - 4. Samples.
  - 5. Informational Submittals.
  - 6. Delegated Design.
- B. Administrative Submittals: Refer to General Conditions, other Division 01 Sections and other Contract Documents for requirements for administrative submittals. Such submittals included, but are not limited to:
  - 1. Permits.
  - 2. Contractor's Construction Schedule.
  - 3. Submittal Schedule.
  - 4. Schedule of Values.
  - 5. Applications for payment.
  - 6. List of Subcontractors.
- C. Related Sections include the following:
  - 1. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
  - 2. Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
  - 3. Division 01 Section "Closeout Procedures" for submitting warranties.
  - 4. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
  - 5. Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
  - 6. Divisions 2 through 48 Sections for specific requirements for submittals in those Sections.



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### 1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect and Construction Manager's responsive action.
- B. Informational Submittals: Written information that does not require Architect and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements.
- C. Concurrent Review: Simultaneous review by Architect and other discipline(s).
- D. Shop Drawings: Original fabrication drawings.
- E. Product Data: Manufacturer's standard product literature and samples.

### 1.4 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Submittals Schedule: Comply with General Conditions and other requirements of the Contract Administration Division. A submittal schedule will be developed by the Contractor within 10 working days of Notice to Proceed and approved by the Architect within 10 working days after receipt for review.
  - 1. **Follow the submittal requirements listed in this Section and elsewhere throughout the Contract Documents however and in addition to submittals required in other specification sections, one (1) copy of all HVAC, sprinkler, plumbing, electrical, and control system submittal must be forwarded to the Owner's Project Manager. At minimum, for submittals other than those listed under this item a transmittal must be forwarded to the Owner's Project Manager.**
- C. Contractor shall record all submittal information on the required "Submittal Log". Distribute Log at each progress meeting.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  - 1. Initial Review: Allow 10 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.

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2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 5 working days for review of each resubmittal.
  4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 10 working days for initial review of each submittal. Submittal will be returned to Contractor, through Architect. Submittals in the following sections require concurrent consultant review:
    - a. Division 03: All Sections.
    - b. Division 05: Sections 05120 "Structural Steel", 05310 "Steel Deck", 05300 "Steel Joists.
    - c. Division 09: Acoustic Sections
    - d. Division 13: All Sections.
    - e. Division 15: All Sections.
    - f. Division 16: All Sections.
  5. Concurrent Transmittal to Consultant: Where indicated above and acceptable to Architect, Contractor may transmit submittals directly to Architect's consultants in the required number of copies, while at the same time transmitting two additional copies of the entire submittal including the transmittal to the Architect.
  6. Concurrent Transmittal to Owner:
    - a. Transmit two (2) additional copies of all shop drawings, product data and coordination drawings and coordination drawings and one (1) set of each sample submittal to Owner's Project Manager.
- E. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
  2. Provide a space approximately 4 by 5 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  3. Include the following information on label for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name and address of Contractor.
    - e. Name and address of subcontractor.
    - f. Name and address of supplier.
    - g. Name of manufacturer.
    - h. Submittal number or other unique identifier, including revision identifier.
      - 1) Architect will assign own numbers to each submittal, which may be different than those assigned by the Contractor.
    - i. Number and title of appropriate Specification Section, and Keynote reference where applicable.
    - j. Drawing number and detail references, as appropriate.
    - k. Other necessary identification.
- F. Deviations: Encircle or otherwise specifically identify deviations from the Contract Documents on submittals.

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1. No deviation or substitutions will be considered without a credit value, and subsequent approval from the Owner's Project Manager.
- G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
1. Submit specified number of copies of submittal to concurrent reviewer in addition to one complete copy and transmittal to Architect.
  2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
1. Transmittal Form: Provide locations on form for the following information:
    - a. Project name.
    - b. Date.
    - c. Destination (To:).
    - d. Source (From:).
    - e. Names of subcontractor, manufacturer, and supplier.
    - f. Category and type of submittal.
    - g. Submittal purpose and description.
    - h. Specification Section number and title.
    - i. Drawing number and detail references, as appropriate.
    - j. Submittal and transmittal distribution record.
    - k. Remarks.
    - l. Signature of transmitter.
  2. On the transmittal record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's Certification that information complies with Contract Document requirements.
- I. Contractor's Certification: All scale and full-size shop, erection or setting drawings, roughing drawings, sleeve and opening drawings, product data, and samples shall be examined and checked by qualified technical employees of Contractor as to accuracy, completeness and compliance with all contract documents prior to submission to the Architect for his review. These drawings, data and samples shall be stamped and signed by Contractor certifying to such examination and compliance. Any drawings, data and samples not checked, stamped, and signed by Contractor will be returned unchecked, to Contractor. Contractor will be held responsible for any delay in the progress of the work due to his failure to observe these requirements, and the time for the completion of his contract will not be extended on account of his failure to submit drawings, data and samples promptly in accordance herewith.
- J. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked "No Exceptions Taken", or "Make

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Corrections Noted".

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- K. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, and authorities having jurisdiction, and others as necessary for performance of construction activities. Furnish one (1) copy of final submittals to Owner. Show distribution on transmittal forms.
- L. Use for Construction: Use only final submittals with mark indicating "No Exceptions Taken" or "Make Corrections Noted" by Architect.
- M. In instances where sepias, shop drawings and/or erection of drawings of a scale larger than the contract drawings are prepared by a contract, such drawings and sepias will be accepted in lieu of marked-up contract drawings provided they are updated according to the contract documents. A master sheet of the same dimensions as the contract drawings shall be prepared by the contractor on a tracing which shall indicate, sheet by sheet, a cross-reference to all shop drawings pertaining to that drawing. All drawings and sepias as required by Section 2.8 F below, shall be labeled "as-built" and dated above the tile block.

### 1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

- A. General: Architect may provide electronic copies of CAD files of the Contract Drawings for Contractor's use in preparing submittals subject to execution by the Contractor of a waiver and payment to the Architect for this service in the amount of \$250. In accordance with the language of the waiver, the agreement is non-transferable by the Contractor to any Subcontractor, from any Subcontractor to the Contractor or from any Subcontractor to another Subcontractor. A separate waiver and payment is required for each individual contractor or subcontractor requesting electronic copies of CAD Drawings.
  - 1. This service is not available prior to the award of the contract.
  - 2. Architect's consultants may or may not provide CAD files under the above agreement. Such consultants reserve the right to refuse to provide CAD files, regardless of whether or not the aforementioned waiver and fee agreement is executed. Consultants may, if they agree to provide CAD files, attach additional conditions to those listed above and below. Architect's consultants include the following disciplines: civil, landscape, structural, mechanical, electrical, plumbing, and fire protection. Architect will advise Contractor if any consultants will not provide CAD files prior to executing above agreement.
  - 3. CAD files will be provided in AutoCad 2020 format or newer version only.
  - 4. CAD files will be provided in Architect's office standard conventions for file structure, file names, layering standards, drafting standards, etc. Architect will not make revisions to these standards for the convenience of the Contractor.
  - 5. CAD files may or may not contain differences from the Contract Documents, including work and information related, but not limited to, alternate designs, obsolete designs, addenda, bulletins, construction sketches, and informational sketches. Such differences may or may not be clearly indicated. Where such differences are found, they do not supersede the Contract Documents.

## PART 2 - PRODUCTS

### 2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.

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- B. When the following are specified in individual sections, submit them for review:
  - 1. Shop drawings.
  - 2. Samples for selection.
  - 3. Samples for verification.
  - 4. HVAC Test and Balance Reports.
- C. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- D. Architect will consult with the Owner prior to rendering a decision or approval.

### 2.2 PRODUCT DATA

- A. Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:
    - a. Manufacturer's written recommendations.
    - b. Manufacturer's product specifications.
    - c. Manufacturer's installation instructions.
    - d. Standard color charts.
    - e. Manufacturer's catalog cuts.
    - f. Wiring diagrams showing factory-installed wiring.
    - g. Printed performance curves.
    - h. Operational range diagrams.
    - i. Mill reports.
    - j. Standard product operation and maintenance manuals.
    - k. Compliance with specified referenced standards.
    - l. Testing by recognized testing agency.
    - m. Application of testing agency labels and seals.
    - n. Notation of coordination requirements.
  - 4. Submit Product Data before or concurrent with Samples. Each item of materials listed shall be marked "as specified" or "unspecified" as the case may be.
  - 5. Number of Copies: Submit one original and three copies. For color charts submit four original color charts. One original and one copy will be returned. Reproduction for distribution to subcontractors, manufacturers, fabricators and suppliers is the responsibility of the Contractor.
    - a. Concurrent Submittals to Consultants: Submit one original and three copies to concurrent reviewer and two copies to Architect. In the case of color charts and other non-reproducible information, submit four originals to concurrent reviewer and two original to Architect.
    - b. Concurrent Submittals to Owner: Submit one (1) copy.
    - c. Copy Owner with any transmittals for Product data sent to Architect or Consultants.

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### 2.3 SHOP DRAWINGS:

#### A. Shop Drawings:

1. Shop Drawings are required all new work. Do not use Shop Drawings without an appropriate final stamp indicating action taken.
2. Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
3. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
  - a. Dimensions.
  - b. Identification of products.
  - c. Fabrication and installation drawings.
  - d. Roughing-in and setting diagrams.
  - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
  - f. Shopwork manufacturing instructions.
  - g. Templates and patterns.
  - h. Schedules.
  - i. Design calculations.
  - j. Compliance with specified standards.
  - k. Notation of coordination requirements.
  - l. Notation of dimensions established by field measurement.
  - m. Relationship to adjoining construction clearly indicated.
  - n. Seal and signature of professional engineer if specified.
  - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
4. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 36 by 48 inches.
5. Number of Copies: Submit one original (Contractor's option of bond print or correctable translucent reproducible print) and three additional copies. One original and one copy will be returned. Reproduction for distribution to subcontractors, manufacturers, fabricators and suppliers is the responsibility of the Contractor.
  - a. Concurrent Submittals: Submit one original and three copies to concurrent reviewer and two copies to Architect.
  - b. Concurrent Submittals to Owner: Submit one (1) copy to Owner
  - c. Copy Owner with any transmittals for Product data sent to Architect or Consultants.
6. Special Types of Shop Drawings:
  - a. Sleeve and Opening Drawings: Comply with requirements set forth in the General Conditions.
    - 1) Comply with shop drawing requirements for submittal and review as specified in this Section.
  - b. Roughing Drawings: Furnish manufacturers certified roughing drawings, indicating accurate locations and sizes of all service utility connections, for machinery and equipment requiring such connections. Submit roughing



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drawings together with shop drawings for respective machinery and equipment.

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7. Mechanical/Electrical Shop Drawing Minimum Requirements: Shop Drawings prepared by mechanical specialty trades shall comply with the following minimum requirements:
  - a. The accurate dimensions locate all horizontal ducts from column centerline. Locate all offsets, transitions, elbows, fire dampers, registers, grilles and diffusers.
  - b. All components shall be located to avoid recessed lighting, piping, conduits, cable trays and other in-plenum assemblies and where required shall be located so as to provide access to the component through removable ceiling material panels or access doors.
  - c. Vertical riser ducts shall be located and dimensioned from column centerlines in two (2) directions. Each vertical duct riser shall be shown in its total length when concealed inside of a shaft.
  - d. Each horizontal duct run shall be drawn to scale and size (width and depth noted) and an ELEVATION (bottom of duct) be clearly noted. This elevation shall clear all beams in the floor above and the ceiling construction below.
  - e. Sheet metal shop drawings shall be made using not less than ¼" scale per foot; increase scale as required in congested areas or as directed by the Contractor.
8. All piping, including fire protection, storm, sanitary, domestic, heating and cooling systems.
  - a. Give location of lines from column centerlines, indicate size, indicate centerline ELEVATION of piping and indicate drainage pitch as required.
  - b. Where a piping line is indicated locate centerline ELEVATION and pitch at intervals not to exceed twenty (20) feet.
  - c. Priority status shall be accorded preparation of dimensioned piping drawings for all piping below slabs-on-grade. Show all line pitches, critical inverts, in-slab fixtures as drains, floor sinks, troughs, cleanouts, etc. and outfall tie-in to site plumbing. Coordinate under slab piping with arrangement(s) of equipment furnished by others where applicable.
9. Electrical Trade:
  - a. Plan layouts, not less than ¼" scale, of transformer vaults, main electrical rooms, satellite electrical and/or communications closets, emergency generator spaces showing equipment to scale and locations thereof.
  - b. Main feeder distribution routing, horizontal and vertical sweep transitions to scale, of conduit over 1" showing ceiling plenum to scale.
10. Coordination:
  - a. Coordination of the work of the several trades and the fitting and routing of the systems within concealed areas to avoid conflicts is the responsibility of the contractor(s). The Architect reserves the right to request coordinated drawings of congested areas showing all systems in plan and section to appropriate scale to insure the proper fitting of the work. The Contractor shall comply if so requested by the Architect.
  - b. Provide coordinated drawings of all main mechanical, electrical, communications, and other rooms listed below showing equipment required by all trades including structure, piping, hanger assemblies, HVAC ductwork, conduit, electrical devices, fire alarm devices, control centers, pipe grids,

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acoustic enclosures, other devices. Drawings dimensioned in both plan and section(s); not less than 3/8"=1'-0" scale.

### 2.4 COORDINATION DRAWINGS

- A. Prepare and submit Coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components. See paragraph 2.3.9 above.
1. Show the interrelationship of components shown on separate Shop Drawings.
  2. Indicate required installation sequences.
  3. Refer to "General Provisions" Sections for specific Composite Drawing requirements for mechanical and electrical installations.
- B. Role of Expediter: Contractor shall be responsible for expediting the preparation of the Coordination Drawings. Actual preparation of the drawings is described below. Contractor shall meet with subcontractors to develop a format for the Coordination Drawings (e.g. CAD, pin-register drafting, conventional drafting on Mylar using multiple pencil colors, etc.) such that reproductions obtained from the final Coordination Drawings can distinguish between the work of the various trades. Contractor shall resolve all conflicts arising in the coordination process.
- C. Preparation Responsibility: Preparation of Coordination Drawings is the responsibility of the Contractor and all subcontractors principally involved. Production of the drawings shall proceed as follows:
1. HVAC subcontractor shall initiate the drawings by indicating his work, drawn at a scale of 3/8" per foot, showing dimensions, layouts, elevations and sections, all in relation to building construction (all steel structure, floor / roof slabs, ceilings, beams and columns).
  2. Where applicable, the GWB subcontractor shall indicate the layout of all acoustic ceiling construction extent including all hanger devices and locations. AC ceiling construction indicated as well.
  3. Fire Protection subcontractor shall then indicate the layout, sizes, dimensions and elevations of his work, using the HVAC subcontractor's drawings as a base, with dimensions in reference to fixed building construction.
  4. Electrical subcontractor shall add his work to the base drawings begun by HVAC and Fire Protection subcontractors. Indicate locations and dimensions of light fixtures and electrical equipment conduit/cable-tray infrastructure, fire alarm equipment with reference to fixed building construction.
  5. Plumbing subcontractor shall then add layouts, sizes and elevations of his work to the drawings of the above-mentioned trades, also dimensioned with reference to building structure.
- D. Conflicts arising between the work of several trades shall be resolved between the respective trades, with the assistance of the General Contractor as expeditor; and the drawings revised. Final Coordination Drawings shall be submitted by the Contractor to the Architect as required for submittals.

### 2.5 SAMPLES:

- A. Submit Samples for review of kind, color, pattern, and texture for a check of these

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characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

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1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
  - a. Generic description of Sample.
  - b. Product name and name of manufacturer.
  - c. Sample source.
  - d. Number and title of appropriate Specification Section.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
  - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
  - a. Number of Samples: Submit three full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
  - a. Number of Samples: Submit four sets of Samples. Architect will retain one Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
    - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
    - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

### 2.6 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
  1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
  2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. An officer shall sign certificates and certifications or other individual authorized to sign documents on behalf of that entity.

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3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
  
- B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Coordination."
  
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names.
  
- D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
  
- E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  
- F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  
- G. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
  
- H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
  
- I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
  
- J. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
  
- K. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  1. Name of evaluation organization.
  2. Date of evaluation.
  3. Time period when report is in effect.
  4. Product and manufacturers' names.
  5. Description of product.
  6. Test procedures and results.
  7. Limitations of use.
  
- L. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."

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- M. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- N. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- O. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- Q. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
  2. Required substrate tolerances.
  3. Sequence of installation or erection.
  4. Required installation tolerances.
  5. Required adjustments.
  6. Recommendations for cleaning and protection.
- S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits

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of coverage, amounts of deductibles, if any, and term of the coverage.



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### 2.7 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

### 2.8 ADMINISTRATIVE SUBMITTALS

- A. Contractor's Construction Schedule: Comply with the General Conditions and other requirements of the Contract Administration Division.
  - 1. If preliminary schedule requires revision after review, submit revised schedule within 5 business days.
  - 2. Submit updated schedule with each Application for Payment.
- B. Submittals Schedule: Comply with the General Conditions and other requirements of the Contract Administration Division.
  - 1. Submit updated Submittal Log with each Application for Payment.
- C. Application for Payment: Comply with the General Conditions and other requirements of the Contract Administration Division.
- D. Schedule of Values: Comply with the General Conditions and other requirements of the Contract Administration Division.
- E. Subcontract List: Comply with the General Conditions and other requirements of the Contract Administration Division. Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.
  - 4. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Architect will return two copies.
    - a. Mark up and retain one returned copy as a Project Record Document.

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5. Submit one (1) copy of initial subcontractor list to Owner within (10) business days after Owner's Notice to Proceed. No portion of the work shall be started until the Contractor has furnished the Owner with a list showing the sub-contractor and/or material supplier responsible for the portion of the actual work needing to be started. The list will be updated until the list reflects the complete group of all subcontractors, suppliers, vendors, etc. employed to carry out the work.
  
- F. The contractor shall keep one (1) set of drawings on the project at all times which are to be marked "as-built". During the course of the project, they shall mark these drawings with colored pencils to reflect any changes as well as dimension, the location of all pipe runs, conduits, traps, footing depths or any other information not already shown on the drawings or differing there from. All buried utilities outside the building shall be located by a metes and bounds survey performed by a licensed surveyor who shall certify as to its accuracy. These marked-up drawings and surveys shall be made available to the contracting officer, the Construction Manager and the Architect/Engineer at any time during the progress of the work upon their request. These shall include the drawings of principal sub-contractors as well. The Owner's Project Manager as well as the Architect on a monthly basis as a prerequisite to the review of the contractor's payment applications will review as-built drawings.

### 2.9 SUBMITTALS FOR PROJECT CLOSE OUT

- A. When the following are specified in individual sections, submit them at project closeout:
  1. Project record documents.
  2. Operation and maintenance data
  3. Warranties.
  4. Bonds (if and when required by the Owner).
  5. Other types as indicated.
  
- B. Manufacturers' Instructions, Product Literature, Certificates, and Reports.
  1. All instructions, literature, certificates, test reports, other technical data and correspondence shall be submitted in four (4) copies. The Owner shall retain Two (2) copies, and the other two (2) returned to the Contractor.
  
- C. Written Certifications
  1. Provide written certifications where required, in the following formats:
    - a. Manufacturer's Written Certifications: Shall be submitted in letter form on the manufacturer's letterhead, signed by an authorized representative, indicating that all required components and elements of their manufacture are in conformity with the requirements so stated under the individual sections of these Specifications. Technical data, additional support material, or other information may be submitted with the certification letter.
    - b. Installer's Written Certifications: Shall be submitted in letter form on the installer's company letterhead, signed by a legal authorized company officer, indicating that their respective installation and/or Work are in conformity with the requirements so stated under the individual sections of these Specifications.
  
- D. Submit all of the above items in this Section for the Owner's benefit during and after project completion.

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### PART 3 - EXECUTION

#### 3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect. The Architect / Consultants will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

#### 3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
  - 1. Final Unrestricted Release: When submittals are marked "No Exceptions Taken" (NET), that part of the Work covered by the submittal may precede provided it complies with requirements of the Contract Documents; final acceptance will depend upon compliance.
  - 2. Final-But-Restricted Release: When submittals are marked "Make Corrections Noted" (MCN), that part of the Work covered by the submittal may precede provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
  - 3. Returned for Resubmittal: When submittal is marked "Amend and Resubmit" (AR), do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
    - a. Do not permit submittals marked "Amend and Resubmit" to be used at the Project site, or elsewhere where Work is in progress.
  - 4. Disapproved for Non-Compliance: When submittal is marked "Rejected - See Remarks" (R), Architect's explanation for rejection will be included. Do not proceed with the work. Prepare a completely new submission.
  - 5. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "Action Not Required".
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

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- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.
  
- F. Architect's Review: Review of shop and setting drawings, roughing drawings, sleeve and opening drawings, product data and samples by Architect will be a general review for conformance with design concept and compliance with information given in contract documents only, and shall not relieve Contractor of responsibility for accuracy of such submissions, nor for proper fitting, construction of work, or for furnishings of materials or work required by the contract and not indicated on submissions. Field dimensions, fabrication details, and job fitting are entirely Contractor's responsibility. Review shall not be construed as approving departures from contract requirements. Any proposed deviations from contract requirements, together with Contractor's explanations thereof, shall be stated in the letter of transmittal. Approval of a specific item shall not indicate approval of an entire assembly of which the item is a component. Should contractor check and certify submissions which indicate changes or deviations from the contract documents, and such changes are found acceptable to Architect, any and all additional costs resulting therefrom, including any cost for changes required to adjacent work or the work of other trades shall be the sole responsibility of Contractor.

END OF SECTION 013300

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### SECTION 014000 - QUALITY CONTROL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, general conduct of the Work and Special Requirements, Supplementary Conditions, and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

1. In Divisions 01 through 48 Sections:

- a. The term "Architect" shall be synonymous with the term "Professional".
- b. The terms "Subcontractor", "Sub-subcontractor", "Installer", "Applicator", "Erector" and similar terms are synonymous with the term "Trade Contractor".

##### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality-control services.
- B. Quality-control services include inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by Architect.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
- D. Requirements of this Section relate to fabrication and installation procedures.
1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  2. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
  3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- E. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 01 Section "Coordination".
  2. Division 01 Section "Testing and Inspections".
  3. Division 01 Section "Testing Laboratory Services".
  4. Testing by the Contractor of installed materials and equipment is specified in the Technical Sections (Divisions 02 through 48) of these Specifications.
- F. Testing requirements for real property installed equipment (RPIE) to be furnished by the contractor when such testing is required by code, contract or the manufacturer shall be

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performed in a pre-approved testing laboratory or in the absence of such by the manufacturer or its authorized representative at its place of business. The contractor shall provide a five (5) days' notice to the University and Architect/Engineer through the Owner's Project Manager. The University and the Architect/Engineer shall have the right to witness all tests.

- G. The contractor will hire and pay for a qualified testing agency.

### 1.3 DEFINITIONS

- A. **Quality-Assurance Services:** Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. **Quality-Control Services:** Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.
- C. **Mockups:** Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockups establish the standard by which the Work will be judged.
- D. **Testing Agency:** An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

### 1.4 RESPONSIBILITIES

- A. **Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and/or required by authorities having jurisdiction. Costs for these services are included in the Contract Sum.**
1. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are to be done these services will be the Contractor's responsibility. The Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are included in the Contract Sum.
- B. **Retesting:** The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Contractor's responsibility.
1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements. The contractor shall pay for all costs including administrative cost incurred by the University.
2. When the University and/or Architect/Engineer require special or additional inspections, testing or approvals due to Contractor's failure to comply with contract

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specifications, industry standards, good building practices, any applicable code procedures including but not limited to ASIC, ASTM, etc., whether or not testing is required by the contract documents for any individual component, entire system or process, the Contractor will secure the service of such special or additional inspections, testing or approvals. In the event such special or additional inspections and testing reveal a failure of the work to comply with the terms and conditions of the contract, the contractor shall also bear all costs necessary to repair or replace the work as required by the Architect/Engineer.

- C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
1. Provide access to the Work.
  2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
  3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
  4. Provide facilities for storage and curing of test samples.
  5. Deliver samples to testing laboratories.
  6. Provide the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
  7. Provide security and protection of samples and test equipment at the Project Site.
- D. Duties of the Testing Agency: The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Architect, the Contractor and the Owner in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.
1. The agency shall notify the Architect, the Contractor, and the Owner promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
  3. The agency shall not perform any duties of the Contractor.
- E. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

### 1.5 SUBMITTALS

- A. Submit a certified written report of each inspection, test, or similar service.
1. Distribute copies of each report to Owner, Architect and Engineer. Distribution of reports shall be made promptly, upon the completion of each test or inspection. **A field report will be distributed to the Owner's Project Manager prior to the Inspector leaving the jobsite on any day during which a test or inspection has been done. A final inspection report will be required from the inspection agency to all parties within five (5) business days following the inspection. Test reports**

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**will be required within (5) business days following the actual test date.**

2. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
3. Report Data: Refer to specification sections of Divisions 02 through 48 for submittal requirements applicable to inspection and test reports. In general, each report shall include:
  - a. Date of issue.
  - b. Project title and number.
  - c. Name, address, and telephone number of testing agency.
  - d. Dates and locations of samples and tests or inspections.
  - e. Names of individuals making the inspection or test.
  - f. Designation of the Work and test method.
  - g. Identification of product and Specification Section.
  - h. Complete inspection or test data.
  - i. Test results and an interpretation of test results.
  - j. Ambient conditions at the time of sample taking and testing.
  - k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
  - l. Name and signature of laboratory inspector.
  - m. Recommendations on retesting.



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4. All submittals of inspections and test reports or requests for approval shall be accompanied by a certification signed by the contractor attesting to his/her knowledge of the submittal, acceptance of its findings and acknowledgement that material tested meets the required standards and certify the report's representation of the facts. Failure to provide the written certification shall be grounds for rejection of the submittal.

### 1.6 QUALITY ASSURANCE

- A. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are prequalified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.
  1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.
  2. Each independent inspection and testing agency engaged on the Project shall be pre-qualified by the Division of Building and Construction of the State of New Jersey to perform the types of tests and inspections required.

### PART 2 - PRODUCTS (NOT USED)

### PART 3 - EXECUTION

#### 3.1 REPAIRS AND PROTECTION

- A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes.
  1. Comply with Contract Document requirements for Division 01 Section "Cutting and Patching."
  2. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
  3. Restore patched areas and extended restoration into adjoining areas in a manner that eliminates evidence of patching.
- B. Protect construction exposed by or for quality control service activities, and protect repaired construction.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 014000

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### SECTION 014100 - TESTING LABORATORY SERVICES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general conditions, general conduct of the work and special requirements, supplementary conditions, and other Division 01 specification sections, apply to this section. In the event of any conflicts between the requirements of these sections, the more stringent requirement shall apply.

##### 1.2 SECTION INCLUDES

- A. Selection and payment.
- B. Contractor submittals.
- C. Laboratory responsibilities.
- D. Laboratory reports.
- E. Limits on testing laboratory authority.
- F. Contractor responsibilities.

##### 1.3 RELATED SECTIONS

- A. General Conditions: Inspections, testing, and approvals required by public authorities.
- B. Individual Specification Sections: Inspections and tests required, and standards for testing.
- C. Drawings and general provisions of the Contract, including General Conditions, General Conduct of the Work and Special Requirements, Supplementary Conditions, and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these sections, the more stringent requirement shall apply.

##### 1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM): ASTM C802 - Practice for Conducting an Interlaboratory Test Program to Determine the Precision of Test Methods for Construction.
- B. ASTM C1077 - Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
- C. ASTM D290 - Recommended Practice for Bituminous Mixing Plant Inspection.
- D. ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

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- E. ASTM D4561 - Practice for Quality Control Systems or an Inspection and Testing Agency for Bituminous Paving Materials.
- F. ASTM E329 - Practice for Use in the Evaluation of Inspection and Testing Agencies as Used in Construction.
- G. ASTM E548 - Practice for Preparation of Criteria for Use in the Evaluation of Testing Laboratories and Inspection Bodies.
- H. Testing, Quality Assurance, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM Committee E6.

### 1.5 SELECTION AND PAYMENT

- A. Contractor shall employ and pay for services of an independent Testing Laboratory, and Balancing Laboratory/Organization, approved by Owner and Architect/Engineer, to perform all specified inspecting and testing.
- B. Employment of testing laboratory in NO WAY relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

### 1.6 QUALITY ASSURANCE

- A. Comply with requirements of ASTM C802, ASTM C1077, ASTM D290, ASTM D3740, ASTM D4561, ASTM E329, ASTM E548, and ASTM E699.
- B. Testing Laboratory Qualifications: Shall have been inspected by a nationally recognized inspection agency, acceptable to Owner and Architect/Engineer. Evidence of such inspection and current status shall be provided to Owner and Architect/Engineer. In addition, the approved lab shall document participation in a nationally recognized soils and concrete reference testing program during the twelve (12) months preceding the start of work on this project. Results of reference testing shall indicate an acceptable rating for the laboratory to be considered by the Owner and Architect/Engineer.
- C. Laboratory: Authorized to operate in the State in which Project is located.
- D. Laboratory Staff: Maintain a full time registered Professional Engineer on staff to review services.
- E. Testing Equipment: Shall be calibrated at reasonable intervals with devices of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

### 1.7 CONTRACTOR SUBMITTALS

- A. PRIOR TO START OF WORK, submit testing laboratory name, address, and telephone number, and names of full time registered Engineer and responsible officer.
- B. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

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### 1.8 LABORATORY RESPONSIBILITIES

- A. Test samples of required items submitted by Contractor.
- B. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.
- C. Perform specified inspecting, sampling, and testing of Products in accordance with specified standards.
- D. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- E. Promptly notify Architect/Engineer and Contractor of observed irregularities or non-conformance of Work or Products.
- F. Perform additional inspection and tests required by Architect/Engineer.

### 1.9 LABORATORY REPORTS

- A. After each inspection and test within five (5) business days, promptly submit three (3) copies of laboratory report to Owner, Architect/ Engineer, and to Contractor. Include:
  - 1. Date issued
  - 2. Project title and number
  - 3. Name of inspector
  - 4. Date and time of sampling or inspection
  - 5. Identification of product and specifications section
  - 6. Location in the Project
  - 7. Type of inspection or test
  - 8. Date of test
  - 9. Results of tests
  - 10. Conformance with Contract Documents.
- B. When requested by Architect/Engineer, provide interpretation of test results.

### 1.10 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory MAY NOT release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Laboratory MAY NOT approve or accept any portion of the Work.
- C. Laboratory MAY NOT assume any duties of Contractor.
- D. Laboratory HAS NO authority to stop the Work.

### 1.11 CONTRACTOR RESPONSIBILITIES

- A. Deliver to laboratory at designated location, adequate samples of materials proposed to be used, which require testing.

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- B. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
- C. Provide incidental labor and facilities:
  - 1. to provide access to Work to be tested,
  - 2. to obtain and handle samples at the site or at source of Products to be tested,
  - 3. to facilitate tests and inspections,
  - 4. to provide storage and curing of test samples.
- D. Notify Architect/Engineer, Owner and laboratory 24 hours prior to expected time for operations requiring inspecting and testing services.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 014100

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### SECTION 014523 – TESTING AND INSPECTIONS

#### PART 1 - GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

##### 1.2 SECTION INCLUDES

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the testing and inspection requirements as specified herein.

##### 1.3 RELATED SECTIONS

- A. Requirements for testing and inspection shall be described in various Sections of these Specifications. Where no testing and inspection requirements are described but the Owner determines that it is necessary, the Owner may request additional testing and inspection to be performed at his own expense.
- B. Work Not Included
  - 1. Unless otherwise noted in this Section or other Section of work, the Owner will select a pre-qualified independent testing laboratory and inspection professional.
  - 2. Unless otherwise noted in this Section or other Sections of work, the Owner will pay for all initial services of the testing laboratory and inspection professionals as further described in Article 2.1 of this Section of these Specifications.

##### 1.4 QUALITY ASSURANCE

- A. The testing laboratory will be qualified to the Owner's approval in accordance with ASTM E 329-14a "Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection."
- B. Testing, when required, will be in accordance with all pertinent codes and regulations and with selected standards of the American Society for Testing and Materials.

##### 1.5 PRODUCT HANDLING

- A. Promptly process and distribute all required copies of test reports and related instructions to ensure all necessary retesting and/or replacement of materials with the least possible delay in progress of the work.

#### PART 2 - PRODUCTS

##### 2.1 PAYMENTS FOR TESTING AND INSPECTION SERVICES

- A. Initial Services: The Owner will pay for all initial testing and inspection services.

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- B. Retesting: When initial tests and inspections indicate non-compliance with local Codes and the Contract Documents, all subsequent retesting occasioned by the non-compliance shall be performed by the same testing laboratory and inspectors and the costs thereof will be deducted by the Owner from the Contract Sum.

### 2.2 CODE COMPLIANCE TESTING AND INSPECTION

- A. Inspections and tests required by Codes or Ordinances, or by a plan approval authority, shall be paid for by the Owner unless otherwise noted in this Section or other Sections of work. Retesting or inspection as required shall conform to the requirements of Article 2.1 B of this Section.

### 2.3 CONTRACTOR'S TESTING

- A. Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.
- B. Where operating tests are specified, the Contractor shall test his work as it progresses, on his own account, and shall make satisfactory preliminary tests in all cases before applying for official tests.
- C. Tests shall be made in the manner specified, for the different branches of the work. Each test shall be made on the entire system for which such test is required, wherever practical. In case it is necessary to test portions of the work independently, the Contractor shall do so without extra compensation. The Contractor shall furnish all labor, material and apparatus, make corrections and conduct the official test. The test will be conducted in the presence of a representative of the Architect.
- D. All parts of the mechanical and electrical work and associated equipment shall be tested and adjusted to work properly and be left in perfect operating condition. All defects disclosed by these tests shall be corrected to the satisfaction of the Architect and Engineer without any additional cost to the Owner. Tests shall be repeated on this repaired or replaced work if deemed necessary by the Architect. The Architect shall be notified at least forty-eight (48) hours in advance of all tests, and shall be represented at tests that he deems necessary. The Contractor shall furnish all necessary instruments, other equipment, and personnel required for such tests.
- E. Required certificates of inspection, testing or approval shall be secured by the Contractor and promptly delivered by him to the Architect.
- F. If the Architect or Engineer is to observe the inspections, tests or approvals required by the Contract Documents, he will endeavor to do so promptly and, where practicable, at the source of supply.

## PART 3 - EXECUTION

### 3.1 COOPERATION WITH TESTING LABORATORY AND INSPECTORS

- A. Representatives of the testing laboratory and inspectors shall have access to the work at all times. Provide facilities for such access in order that they may properly perform their

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functions.

### 3.2 SCHEDULES

- A. Establishing Schedule: By advance discussions with the inspection service and testing laboratory selected by the Owner, determine the time required to perform inspections and tests and to issue each of its findings. Provide all required time within the construction schedule.
- B. Revising Schedule: When changes of construction schedule are necessary during construction, coordinate all such changes of schedule with the inspectors and testing laboratory as required.
- C. Adherence to Schedule: When the testing laboratory is ready to test according to the determined schedule but is prevented from testing or taking specimens due to incompleteness of the work, all extra costs for testing attributable to the delay will be back-charged to the Contractor.

### 3.3 TAKING SPECIMENS

- A. All specimens and samples for testing, unless otherwise provided in these Contract Documents, will be taken by the testing laboratory; all sampling equipment and personnel will be provided by the testing laboratory; and all deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

END OF SECTION 014523



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### SECTION 014200- REFERENCE STANDARDS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, General Conduct of the Work and Special Requirements, Supplementary Conditions, and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 DEFINITIONS

- A. General: Basic contract definitions are included in the Conditions of the Contract.
- B. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference. Location is not limited.
- C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the Architect, requested by the Architect, and similar phrases, unless any item associated with these terms will result in a monetary change order to the project. If the items associated with these terms require a change order the Owner must be notified prior to any action being taken.
- D. "Approved": The term "approved," when used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, and the Architect's and Owners duties and responsibilities are limited as specified by the Conditions of the Contract.
- E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conversations and agreements within the construction industry that control performance of the Work.
- F. "Furnish": The term "furnish" means to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": The term "install" describes operations at the Project site including the actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.

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- I. "Installer": An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.
  - 1. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.
  - 2. Trades: Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name. However, work resulting from any construction activity performed by a "Trade" must meet all quality standards acceptable to the Architect and Owner
- J. "Project site" is the space available to the Contractor for performing construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
- K. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.
- L. If Requested: If requested by the Owner.
- M. Where: Where or when practicable in the judgment of the Owner.
- N. Satisfactory: Acceptable in the judgment of the Owner.
- O. As Required: As required by the Architect, or as field conditions dictate.
- P. Replace: To remove an existing product or service, and furnish and install an indicated product in its place.
- Q. Specifications: The total and complete specifications of this Project as identified by the Architect, and the Architects consultants through the Architect, including referenced standard specifications, the General Specifications and the Technical Specifications as indexed.
- R. System/ Assembly: In the context of this Project, where a 'system' or an 'assembly' as indicated in the Specifications and/or Drawings, it shall consist of the sum of all the relevant parts and/or materials specific to the use of the system or assembly indicated; installed complete, in place, and in working order. All said parts and/or materials required for a complete system indicated, shall be supplied and installed as part of the Base Bid Price for a complete, proper, and fully functional installation, whether specifically detailed or not. All materials for the system or assembly shall be installed completely, all necessary connections to other construction shall be provided. Upon completion of this system or assembly, the sum of all the parts that constitute the make-up of this unit, shall function and/or operate properly according to its intended design.

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- S. **Mandatory:** Means as required by code, any Building Authority, and any and all governing laws. All mandatory requirements for construction shall be included in the Base Bid Price for the Project.
- T. **Functional:** Items(s) installed that are to operate properly or as intended.
- U. **Typical:** A condition, detail, or other item that is common to an identified system, assembly, or any other construction condition where the essential characteristics are the same.

### 1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

- A. **Specification Format:** These Specifications are organized into Divisions and Sections based on the 48-division format and CSI/ICSC's "MasterFormat" numbering system.
- B. **Specification Content:** These Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows.
  - 1. **Abbreviated Language:** Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated, as the sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
    - a. The Technical Specifications are of the abbreviated type and include incomplete sentences. Omissions of words or phrases such as "the Contractor shall"; "in conformance with"; "shall be"; "as noted on the Drawings"; "according to the Plans"; "a" "an"; "the"; and "all" are intentional. Omitted words and phrases shall be supplied by inference in the same manner, as they are when a "note" occurs on the Drawings. Works "shall be" "shall have", and "shall" will be supplied by inference where a colon (:) is used within sentences or phrases.
  - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Section Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.
    - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
    - b. Abbreviated references to trade associations, technical societies, recognized authorities and other institutions are included in the contract documents. Any abbreviation or organization not recognized by the Contractors shall be requested from the Architect for interpretation. Failure to request and receive an interpretation shall not relieve the Contractor from performing and/or supplying materials or workmanship in compliance with specified references to the satisfaction of the Architect or Owner
- C. **References:** References to known standard specifications shall mean and intend the latest edition of such specifications adopted and published as of the date of the invitation to bid.
- D. **Divisions:** Divisions of the specifications into sections is done for the convenience of reference and is not intended to control the Contractor in dividing the Work among

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subcontractors or to limit the scope of work performed by any trade under any section

### 1.4 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of the date of the Contract Documents.
- C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to the Architect for a decision before proceeding.
  - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the Architect for a decision before proceeding
- D. Copies of Standards: Each entity engaged in construction on the Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source and make them available on request.
- E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-producing organization, authorities having jurisdiction, or other entity applicable to the context of the text provision. Refer to Gale Research's "Encyclopedia of Associations" or Columbia Books' "National Trade & Professional Associations of the U.S.," which are available in most libraries.

### 1.5 GOVERNING REGULATIONS AND AUTHORITIES

- A. Copies of Regulations: Obtain copies of the following regulations and retain at the Project site to be available for reference by parties who have a reasonable need:
  - 1. Any and all Federal, State or Local regulations required by the Agency having jurisdiction to be retained or posted at the project site

### 1.6 SUBMITTALS

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

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Work.

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### 1.7 DRAWINGS

- A. The Contractor shall provide all quantities, items, articles, materials, operations, or methods listed, mentioned, implied, scheduled, or specified, on the Drawings, including all labor, materials, equipment, and incidentals required for their completion.
  
- B. Intent of the Drawings:
  - 1. As with any plan, the Contractor shall be responsible for verifying all field conditions, whether or not noted in the plans prior to construction. Any discrepancies shall be resolved with the Owner prior to construction. The start of construction will not be delayed due to the Contractor's need to verify all field conditions. Verification of items must be scheduled by the Contractor so as not to impede the progress of the work. The Contractor shall be responsible for correcting damage resulting from Contractor's failure to verify field conditions. Architect/Engineer and Owner liability for accuracy of survey information.
  - 2. The implied intent of the Drawings, includes the overall layout of the Project, inclusive of site structures, site improvements, location of all items required during construction, the extent of construction and the extent of the materials.
  - 3. All such Drawings and Specifications constitute the Project as a whole, and are as a result, directly related to one another. The Drawings and Specifications are not divided into, or are intended to be divided into separate entities according to building trades or local practice. It is the responsibility of the Contractor to disseminate all information represented on the Drawings and Specifications so that all trades and sub-trades will have complete and thorough knowledge of the Project intent. No requests for Change Orders, time extensions, or other considerations will be accepted if the Contractor fails to properly coordinate information to the various trades/sub-trades.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 014200

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### SECTION 015000 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, Supplementary Conditions, and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 SUMMARY

- A. This Section includes requirements for construction facilities and temporary controls, including temporary utilities, support facilities, and security and protection. Temporary utilities include, but are not limited to, the following:
  - 1. Temporary water service and distribution.
  - 2. Temporary electric power and light.
  - 3. Temporary heat.
  - 4. Telephone service.
  - 5. Sanitary facilities, including drinking water.
  - 6. Storm and sanitary sewer.
- B. Support facilities include, but are not limited to, the following:
  - 1. Field offices and storage sheds.
  - 2. Temporary roads, paving and truck wash-down station.
  - 3. Dewatering facilities and drains.
  - 4. Temporary enclosures.
  - 5. Hoists.
  - 6. Temporary project identification signs and bulletin boards.
  - 7. Waste disposal services.
  - 8. Rodent and pest control.
  - 9. Construction aids and miscellaneous services and facilities.
- C. Security and protection facilities include, but are not limited to, the following:
  - 1. Temporary fire protection.
  - 2. Barricades, warning signs, and lights.
  - 3. Sidewalk bridge or enclosure fence for the site.
  - 4. Environmental protection.
- D. The Contractor is responsible for all costs associated with the supply, maintenance or usage of temporary utilities and construction related facilities unless indicated otherwise in this Section.

##### 1.3 QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations of

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authorities having jurisdiction including, but not limited to, the following:

1. Building code requirements.
  2. Health and safety regulations.
  3. Utility company regulations.
  4. Police, fire department, and rescue squad rules.
  5. Environmental protection regulations.
- B. Standards: Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."
1. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 "National Electric Code."
- C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

### 1.4 PROJECT CONDITIONS

- A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.
- C. Provide waste removal services as required to maintain the site in a clean and orderly condition.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Provide new materials. If acceptable to the Owner, the Contractor may use undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.
- B. Paint: Comply with requirements.
1. For job-built temporary offices, shops, sheds, fences, and other exposed lumber and plywood, provide exterior-grade acrylic-latex emulsion over exterior primer.
  2. For sign panels and applying graphics, provide exterior-grade alkyd gloss enamel over exterior primer.
- C. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.



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- D. Water: Provide potable water approved by local health authorities.

### 2.2 EQUIPMENT

- A. General: Provide new equipment. If acceptable to the Owner, the Contractor may use undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.
- B. Water Hoses: Provide 3/4-inch, heavy-duty, abrasion-resistant, flexible rubber hoses 100 feet long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.
- C. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-Volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.
- D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
- E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage.
- F. Fire Extinguishers: Provide hand-carried, portable, UL-rated; Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for the exposures.
  - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work and the areas adjacent to the Work area. Relocate and modify facilities as required.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed.

### 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.

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1. Arrange with company and existing users for a time when service can be interrupted, if necessary, to make connections for temporary services.
  2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
  3. Obtain easements to bring temporary utilities to the site where the Owner's easements cannot be used for that purpose.
  4. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner. Neither the Owner will accept cost or use charges as a basis of claims for Change Orders.
  5. Install services to cause minimum disruption to area's adjacent to the work area.
  6. Add provisions for work not in Contract but served by temporary facilities, if required.
- B. Water Service: Contractor may use existing water service in the area of work.
- C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnects, automatic ground-fault interrupters, and main distribution switchgear. **Cost of temporary electric power usage is the Contractors responsibility. Cost shall be included in the bid.**
- D. Initial temporary service shall be three (3) phase, or single phase. Temporary light and power installations, wiring and miscellaneous electrical hardware must meet the electric code. Electrical characteristics shall be provided to meet all temporary light and power reasonably required as herein and hereinafter specified or as included under the general conditions. The contractor shall pay the cost of running temporary services. **All costs shall be included in the bid.**
1. Power Distribution System: Install wiring overhead and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, ac 20 Ampere rating, and lighting circuits may be nonmetallic-sheathed cable where overhead and exposed for surveillance.
- E. Power outlets shall be fed independently of the temporary lighting system. The extension of service shall include the necessary wiring of sufficient capacity to the location of the well for the operation of the well pump in the event a water well is the source of water supply for the project. Where service of a type other than herein mentioned is required, the contractor requiring it shall pay all costs of such special service.
- F. Temporary Lighting: Provide temporary lighting with local switching. **Cost of temporary lighting usage is the contractors' responsibility. Cost shall be included in the bid.**
1. The contractor shall provide double sockets at a maximum of thirty feet (30') on centers in large areas. One (1) socket shall contain a 150-watt lamp and the other socket shall be a grounding type to accept a receptacle plug for small, single-phase loads to be used for short periods of time.
  2. Install and operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide temporary lighting that will provide adequate illumination for construction operations and traffic conditions.
- G. The contractor shall observe the requirements of the Federal Occupational Safety and Health Act (OSHA) of 1970 with regard to temporary light and power.

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- H. Temporary Heat: Provide temporary heat required by construction activities. Select safe equipment that will not have a harmful effect. **Any cost associated with the supply, maintenance and usage of temporary heat will be the responsibility of the contractor. Cost of temporary heat shall be included in the bid.**
- I. Use of gasoline-burning space heaters, open flame, or salamander heating units is prohibited.
- J. Should electricians be required to supervise and maintain equipment required for the provision of heat, the payment for the services of the supervisors and/or maintenance personnel shall be the responsibility of the Contractor. The contractor shall pay the cost of all fuel consumed in the operation of the generating unit for supplying temporary heat.
- K. All heating equipment shall be NFPA approved. Heaters shall be approved by a recognized testing laboratory and must be equipped with a positive shut-off safety valve. Notwithstanding the above, all temporary heating equipment will comply with all Federal and State laws and regulations.
- L. Temporary Telephones: Contractor shall utilize their own cell phones for service.
- M. The contractor may utilize the Owner's sanitary/wash facilities, drinking water, etc. if these amenities are available. The contractor shall only use these facilities with Owner's permission. The contractor will be responsible to reimburse the Owner for all Owner provided utilities use by the Contractor. Further, should the contractor elect to utilize Owner provided utilities the contractor will be responsible to repair all damage and replace all damaged items before the project will be considered substantially completed. The Owner will not be required to make final payment to the contractor until such damage is repair or replaced to its original or better than original condition.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. Temporary storage sheds are not permitted on the Owner's property.
- B. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.
  - 1. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use UL-labeled, fire-retardant-treated material for framing and main sheathing.
- C. Temporary Lifts and Hoists: Contractor may utilize the existing elevator for bringing materials to the area of work and disposing materials to the area of work provided that:
  - 1. The Contractor provides temporary protection materials, padding, etc. for the elevator cab.
  - 2. The Contractor observes the weight capacity of the existing elevator cab.
  - 3. The Contractor is only permitted to use the existing elevator from the hours of 9:00 p.m. to 6:00 a.m. Monday through Friday.
  - 4. The Contractor notify the Owner of the elevator use three (3) business days prior to use.
- D. Project Identification and Temporary Signs: Prepare project identification and other signs of size indicated. Install signs where indicated to inform the public and persons seeking

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entrance to the Project. Support on posts or framing of preservative-treated wood or steel. Do not permit installation of unauthorized signs.

1. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.
- E. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.
1. Provide containers with lids. Dispose of waste off-site periodically.
- F. Individual Project circumstances may require use of other construction aids and miscellaneous facilities, such as walkways, scaffoldings, platforms, swing stages, ramps and bridges, incidental sheeting and shoring, demolition waste chutes, and similar construction aids. Add requirements as necessary to suit Project.

### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers" and NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations."
1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stair- well.
  2. Store combustible materials in containers in fire-safe locations.
  3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.
  4. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
- B. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.
- C. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.
- D. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result. Avoid use of tools and equipment that produce

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harmful noise. Restrict use of noise-making tools and equipment to hours that will minimize complaints from persons or firms near the site.

1. No burning will be permitted on the site.
2. It will be the Contractor's responsibility to control dust by a means acceptable to the Owner. The Contractor shall make due allowance in his bid to cover these non-productive costs.

### E. Protection of Utilities:

1. The Contractor shall exercise special care when working near existing utility installations such as lights, ducts, structures, underground trench laid cables, cable markers, pads, water lines, underground oil lines, railroads and other installations, to ensure that no damage is done to them and that the underground wiring to such utilities is not damaged or rooted out, or pipelines broken or punctured.
2. If the Contractor damages any installation, the Contractor shall repair at no cost to the Owner the damaged item to the Owner's satisfaction. At the Owner's discretion, repairs will be done continuously on a 24-hour per day basis until completed. The Contractor shall submit for approval the name of an electrical contractor and a plumbing contractor who shall be available on a 24 hour a day basis to affect any repairs as may be necessary due to Contractor error.
3. The Contractor shall obtain (if available) as-built site underground information prior to beginning excavation to minimize the possibility of interruption or damage to existing facilities. The lack of this information shall not excuse damage to the utilities by the contractor or the requirement to make necessary repairs immediately, the Contractor shall pay for Cost of the repair work.

### F. Protection and Restoration of Property and Landscape: The Contractor shall be responsible for the preservation of all public and private property. All land monuments and property markers shall be preserved until the Owner has witnessed and recorded their location.

### G. Protection of Existing Trees, Shrubs, and Vegetation to Remain: Contractor shall take all means necessary to protect existing trees, shrubs, and vegetation. Contractor and its forces shall abide by the boundaries set by the Drawings for the protection of root systems of all designated trees, shrubs and vegetation. Protection shall be completely in place prior to the start of construction work in any area. Contractor shall clearly mark all restricted areas as indicated on the Drawings and prevent the use of the area by all personnel and equipment until final cleanup.

### H. Project Security:

1. The Contractor shall be responsible for monitoring all personnel requiring access to the work site including his personnel, subcontractor's personnel, other contractors working in the same construction area, material delivery trucks, authorized visitors to the site, etc.
2. The Contractor shall be held responsible for the security and protection of its own, sub-contractors and sub-subcontractors equipment, vehicles, trailers, tools, materials, and all other items necessary for the work under this Contract.
3. The Contractor shall be held responsible for the admission of any unauthorized personnel into his work area.
4. In general, provide security and facilities to protect Work, existing facilities, and the Owner's operations from unauthorized entry, vandalism or theft.

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### 3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
  - 1. Protection: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Termination and Removal: Unless the Owner requests that it be maintained longer, remove each temporary facility when the need has ended or no later than Substantial Completion. Complete or, if necessary, restore existing permanent construction that may have been damaged as a result of the use, maintenance or operation of temporary facility for this project. Repair damaged new work, repair or replace, as directed by the Owner, existing work and or conditions, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired as a result of the use, maintenance or operation of temporary facilities for the project.
  - 1. Where the area is intended for future landscape development, remove any material, equipment, debris, trash, soil and aggregate fill used as part or in conjunction with the project that do not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks damaged during and as a result of work conducted as part of this project. Replace and/or repair as required and direct by the governing authority and the Owner.

END OF SECTION 015000

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### SECTION 016000 – PRODUCT REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

##### 1.2 SECTION INCLUDES

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete product requirements as specified herein, including, but not limited to, the following:

1. Product delivery, storage and handling.
2. Storage and protection.
3. Identifying markings.
4. Temporary use of equipment.
5. General standards.

##### 1.3 RELATED SECTIONS

- A. Substitution Procedures - Section 012500.
- B. Execution Requirements - Section 017300.

##### 1.4 TRANSPORTATION AND HANDLING

- A. Materials, products, and equipment shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.
- B. More detailed requirements for transportation and handling are specified under the technical Sections.

##### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling
  1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  2. Coordinate delivery with installation time to ensure minimum holding time for items

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that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

### C. Storage

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

## 1.6 IDENTIFYING MARKINGS

- A. Name plates and other identifying markings shall not be affixed on exposed surfaces of manufactured items installed in finished spaces.

## 1.7 PRODUCT APPROVAL STANDARDS

- A. Where the words "or approved equal" or other synonymous terms are used, it is expressly understood that they shall mean that the approval of any such submission is vested in the Architect, whose decision shall be final and binding upon all concerned. All submissions are subject to such approval and shall conform to the requirements of Article 1.8 herein.

## 1.8 TEMPORARY USE OF EQUIPMENT

- A. No equipment intended for permanent installation shall be operated for temporary purposes without the written permission of the Architect.
- B. The temporary or trial usage by the Owner of any mechanical device, machinery, apparatus, equipment or any work or materials supplied under this Contract before final completion and written acceptance by the Architect, shall not be construed as evidence of the acceptance of same by the Owner. The Owner shall have the privilege of such temporary and trial usage, for such reasonable length of time as and when the Architect shall deem to be proper for making a complete and thorough test of same and no claim for damage shall be made by the Contractor for the injury to or breaking of parts of such work which may be caused by weakness or inaccuracy of structural parts or by defective material or workmanship. If the Contractor so elects, he may at his own expense, place a competent person or persons to make such trial usage; such trial usage shall be under the supervision of the Contractor.



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### 1.9 GENERAL REQUIREMENTS

- A. In the event that it is necessary for the Contractor to store any materials offsite, he shall first obtain the approval of the Architect. The Contractor shall be responsible for insurance and warehousing charges of any materials stored offsite. The Contractor shall also be responsible for the cost of delivery to the job site of any materials that have been stored offsite.
- B. Materials delivered to the job site shall be carefully stored and protected from damage. Damaged material shall not be used in the work. The Contractor shall provide, where directed temporary storage facilities as may be required for the storage of all materials which might be damaged by weather.
- C. Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the representative manufacturers, unless otherwise specified.
- D. Equipment, plant, and appliances, such as hoists, centering, concrete lifts, construction elevators, cranes, rigging, towers, derricks, walks, ramps, chutes, scaffolding, implements, transportation, cartage and other things necessary and required for the adequate execution of the work and as required by law and applicable Union rules shall be provided and shall be maintained in good and safe mechanical working order, be responsible for their safe use, and remove them when no longer required. Applicable requirements of OSHA shall become and form a part of this document.
- E. During handling and installation of work at project site clean and protect work in progress and adjoining work on a basis of perpetual maintenance. Apply suitable protective covering on newly installed work where reasonably required to ensure freedom from damage or deterioration at time of substantial completion; otherwise, clean and perform maintenance on newly installed work as frequently as necessary through remainder of construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- F. To extent possible through reasonable control and protection methods, supervise performance of work in a manner and by means which will ensure that none of the work whether completed or in progress, will be subjected to harmful, dangerous, damaging, or otherwise deleterious exposures during construction period. Such exposures include (where applicable, but not by way of limitation) static loading, dynamic loading, internal pressures, external pressures, high or low temperatures, thermal shock, high or low humidity, air contamination or pollution, water, ice, solvents, chemicals, light, radiation, puncture, abrasion, heavy traffic, soiling, bacteria, insect infestation, combustion, electrical current, high speed operation, improper lubrication, unusual wear, misuse, incompatible interface, destructive testing, misalignment, excessive weathering, unprotected storage, improper shipping/handling, theft and vandalism.
- G. Require installer of each major unit of work to inspect substrate to receive the work, and conditions under which the work will be performed, and to report (in writing to Contractor) unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
- H. Where installations include manufactured products, comply with manufacturer's applicable instructions and recommendations for installation to whatever extent these are more explicit or more stringent than applicable requirements indicated in the Contract Documents.

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- I. Inspect each item of materials or equipment immediately prior to installation and reject damaged and defective items.
- J. Provide attachment and connection devices and methods for securing work properly as it is installed; true to line and level, and within recognized industry tolerance if not otherwise indicated. Allow for expansions and building movements. Provide uniform joint widths in exposed work, organized for best possible visual effect. Refer questionable visual-effect choices to Architect for final decision.
- K. Recheck measurements and dimensions of the work as an integral step of starting each installation.
- L. Install work during conditions of temperature, humidity, exposure, forecasted weather, and status of project completion which will ensure best possible results for each unit of work in coordination with entire work. Isolate each unit of work from non-compatible work, as required to prevent deterioration.
- M. Coordinate enclosure (closing-in) of work with required inspections and tests, so as to avoid necessity of uncovering work for that purpose.
- N. Mounting Heights: Except as otherwise indicated, mount individual units of work at industry-recognized standard mounting heights, for applications indicated. In CMU walls mount units at height closest to manufacturer's recommendation so as to minimize cutting of block coursings. Refer questionable mounting height choices to Architect for final decision.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

## SECTION 016350 - SUBSTITUTION PROCEDURES

### PART 1 - GENERAL

#### 1 RELATED DOCUMENTS

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

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions and/or equivalent requests.
- B. Related Requirements:
  - 1. Section 012100 "Allowances" for products selected under an allowance.
  - 2. Section 012300 "Alternates" for products selected under an alternate.
  - 3. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

#### 1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
- B. Equivalents: When the products, materials, equipment, and methods are the same to the specified, but supplied and/or manufactured by a firm or vendor not listed in the specifications. In accordance with N.J.S.A. 18A:64-64, equal products, materials and equipment will be considered by the Architect for all products, unless sole source is approved, specified in the bid documents regardless if the language "or equivalent" and/or "or equal" is stated in each specification.

#### 1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit one copy of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

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1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
  - Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
  - Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
  - Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
  - Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - Samples, where applicable or requested.
  - Certificates and qualification data, where applicable or requested.
    - List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  - Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    - Research reports evidencing compliance with building code in effect for Project.
  - Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - Cost information, including a proposal of change, if any, in the Contract Sum.
  - Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
  - Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven (7) calendar days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within fifteen (15) calendar days of receipt of request, or seven (7) calendar days of receipt of additional information or documentation, whichever is later.
  - Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.

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

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed request with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than seven (7) calendar days prior to time required for preparation and review of related submittals.
  - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Requested substitution provides sustainable design characteristics that specified product provided.
    - c. Substitution request is fully documented and properly submitted.
    - d. Requested substitution will not adversely affect Contractor's construction schedule.
    - e. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - f. Requested substitution is compatible with other portions of the Work.
    - g. Requested substitution has been coordinated with other portions of the Work.
    - h. Requested substitution provides specified warranty.
    - i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016350



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### SECTION 017300 – EXECUTION REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

##### 1.2 SECTION INCLUDES

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. General installation of products.
  - 2. Progress cleaning.
  - 3. Starting and adjusting.
  - 4. Protection of installed construction.
  - 5. Correction of the Work.

##### 1.3 RELATED SECTIONS

- A. Cutting and Patching - Section 017329.
- B. Closeout Procedures - Section 017700.

##### 1.4 SUBMITTALS

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

#### PART 2 - PRODUCTS (NOT APPLICABLE)

#### PART 3 - EXECUTION

##### 3.1 EXAMINATION

- A. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
    - a. Description of the Work.
    - b. List of detrimental conditions, including substrates.
    - c. List of unacceptable installation tolerances.
    - d. Recommended corrections.



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4. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  3. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 4.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

### 4.3 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  1. Make vertical work plumb and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
  4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

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- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
- G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 4.4 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg. F.
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
  - 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

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- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 4.5 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Section 014000, "Quality Requirements."

### 4.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide continuous protection during construction of all finishes, including taped Masontie joints, and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

### 3.1 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Section 017329, "Cutting and Patching."
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly.

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- E. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

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### SECTION 017700– CONTRACT CLOSEOUT

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Inspection procedures.
  - 2. Project record document submittal.
  - 3. Operation and maintenance manual submittal.
  - 4. Submittal of warranties.
  - 5. Final cleaning.
- B. Closeout requirements for specific construction activities are included in the appropriate Drawings.

##### 1.3 SUBSTANTIAL COMPLETION

- A. Substantial Completion: The date of Substantial Completion for the Work, or designated portion thereof, is the date certified by the Architect when the construction is sufficiently complete, in accordance with the Contract Documents, so that the Owner may occupy the project, or the designated portions thereof, for the use for which it was intended PRIOR to the Mandatory Completion Date. Substantial Completion shall be accomplished and the full project and all designated portions thereof, read for use and occupancy by the Owner by the completion milestone deadline listed below. It shall be the responsibility of the Contractor to notify the Architect and Owner in not less than seven (7) calendar days prior to the Substantial Completion Milestone deadline for a “substantial completion” inspection. The University shall issue a Certificate of Substantial Completion (AIA Document G704) at the point in time when the inspection has been fully completed and the appropriate approvals and certificates have been granted by governing authorities and obtained by the Contractor.

- 1. IT IS THE INTENT OF THESE SPECIFICAITONS THAT SUBSTANTIAL COMPLETION IS ACHIEVED NO LATER THAN THE DATES AS OUTLINED IN SECTION 011000 “SUMMARY”. **THE CONTRACTOR MUST INCLUDE ANY AND ALL COSTS INCLUDING ANY OVERTIME NECESSARY TO ATTAIN SUBSTANTIAL COMPLETION BY THE DEADLINE LISTED IN SECTION 011000 BASED UPON BEING AWARDED THE PROJECT BY THE DATE LISTED IN SECTION 011000.**

- B. **LIQUIDATED DAMAGES ARE PART OF THIS PROJECT. These will be assessed at the following rates:**

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1. \$1,000.00 per day beyond substantial completion.
- C. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List items below that are incomplete in request.
1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete.
    - a. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
    - b. If 100 percent completion cannot be shown, include a list of incomplete items (a project punch list), the value of incomplete construction, reasons the Work is not complete, and a timeline during which the work must be completed.
  2. Advise Owner of pending insurance changeover requirements.
  3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.
  4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
  6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  8. Complete startup testing of systems and instruction of the Owner's operation and maintenance personnel.
  9. Disconnect and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  10. When mechanical, electrical or other equipment is installed, it shall be the responsibility of the contractor to maintain, warrant and operate it for such period of time as required by the contract documents or as necessary for the proper inspecting and testing of the equipment for adequately instructing the University's operating personnel. All costs associated with the maintenance, warranty, operations, inspection and testing of equipment in addition to instructing University personnel shall be borne by the contractor. All tests shall be conducted in the presence of and upon timely notice to the contracting officer, Owner's Project Manager and Architect/Engineer prior to acceptance of the equipment.
  11. Owner's warranties will start at Final Acceptance of the Project.
- D. Pre-final Inspection:
1. When the Contractor has completed all work and is satisfied the Project is in compliance with the Contract Documents, it will notify the Owner and Architect, in writing, that the Project is complete and ready for inspection. The Owner and Architect will arrange for and conduct an inspection of the Project by the Owner, Architect, Engineers and the Contractor. The Owner will be provided with a reasonable time to arrange for and conduct an inspection.

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2. The Owner and Architect will document any deficiencies on a written punch list and will arrange a meeting with the Contractor to review the punch list, explain deficient items and designate a time frame in which the punch list must be completed. The Contractor will correct all the deficiencies within the designated time frame and notify the Owner in writing, when the Project is ready for re-inspection. The Owner will arrange and conduct the re-inspection of the Project to review the corrected items.
3. The formal list of deficiencies found shall not be considered a final list of all deficient items. Any deficiencies found during instructions to the Owner, inspection for Substantial Completion, beneficial occupancy, or inspection for final acceptance, the Contractor will correct all deficient items per the contract documents prior to final acceptance.

### E. Substantial Completion:

1. Upon completion of deficient items and instruction to the Owner, the Contractor will arrange for an inspection of the Project with the Owner and the Architect. This inspection may result in a list of additional items to complete after occupancy, but before final payment and/or may require additional correction prior to occupancy by the Owner.
2. Upon formal notice from the Owner, the Contractor shall then arrange for the submission of all outstanding record documents, including: maintenance manuals, guarantees, warranties, maintenance contracts, and any additional instructions necessary for the operation of the project. The Contractor shall acquaint the Owner with acceptance tests, guarantees, warranties, and maintenance manuals. The Contractor shall also obtain a 'Certificate of Occupancy' or similar releases required to permit the Owner's occupancy of the Project.
3. Should the instruction period find deficiencies, the Owner will notify the Contractor in writing of deficient items.
4. If the inspection confirms that the Project is 'substantially complete' and is 'ready for occupancy', the Owner through the Architect/Engineer will issue a "Certificate of Substantial Completion". The Certificate will confirm that the Project can be occupied for its intended use. Attached to the Certificate will be any final punch list to be completed. Prior to issuance of the Certificate, the Contractor shall submit a schedule for completion of remaining deficiencies, approved or amended by the Owner.
5. Inspection Procedures: On receipt of a request for inspection, the Architect will either proceed with inspection or advise the Contractor of unfilled requirements. The Architect will prepare the Certificate of Substantial Completion following inspection or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
  - a. The Architect will repeat inspection when requested and assured that the Work is substantially complete.
  - b. Results of the completed inspection will form the basis of requirements for final acceptance.

### 1.4 BENEFICIAL OCCUPANCY

- A. Upon issuance of the 'Certificate of Substantial Completion', the Owner may then occupy the Project (or the designated area of the Project).

### 1.5 FINAL ACCEPTANCE

- A. Final Inspection: Upon completion of any remaining deficiencies the Contractor shall notify

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the Owner in writing, that the Project is complete and ready for final inspection. The Contractor shall arrange for and conduct the final inspection of the Project with the Owner.

- B. Final Acceptance: If the final inspection indicates satisfactory completion of the Work, the Owner through the Architect/Engineer will issue a Change Order adjusting to the final quantities. Following acceptance of the final Change Order, receipt of required affidavits, final release of liens, consent of surety for final payment along with all other documentation required by the contractor documents, the Owner through the Architect will authorize a final Certificate for Payment.
1. Mandatory or Final Completion: Final Completion shall be accomplished and the full project, and all designated portions thereof, completed and ready for use without any further work required within the time frame identified for each phase of work from the date of issuance and as listed on the Certificate of Substantial Completion by the Architect.
  2. The guarantee period for all materials, equipment and workmanship shall start on the date of 'Final Acceptance' unless otherwise noted on the Certificate.
- C. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
  2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
  3. Submit a certified copy of the Architect's final inspection list of items to be completed or corrected, endorsed and dated by the Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by the Architect.
  4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Substantial Completion or when the Owner took possession of and assumed responsibility for corresponding elements of the Work.
  5. Submit consent of surety to final payment.
  6. Submit a final liquidated damages settlement statement.
  7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- D. Re-inspection Procedure: The Architect will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to the Owner.
1. Upon completion of re-inspection, the Architect will prepare a certificate of final acceptance. If the Work is incomplete, the Architect will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
  2. If necessary, re-inspection will be repeated.
  3. Should the Project require inspections beyond the inspections noted above, i.e. a pre-final and a final inspection only the Owner will reduce from the Contractor's final payment those monies necessary to provide for the cost of the additional inspections. The reduction shall not be considered as a part of any "Liquidated Damages" for failure to complete within the specified Contract Time. The reduction shall not be considered as a penalty to the Contractor; but shall be for the actual cost of monies



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required for the reimbursement of fees for the Architect, Engineers, Owner and any other specialists necessary for obtaining final approval of the Work.

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### 1.6 EXCESSIVE DEFICIENCIES

- A. During any inspection for Project completion, if it is determined by the Owner, that the Contractor has not sufficiently completed the Work in compliance with the Contract Documents, the Owner may declare that the Project is not sufficiently complete to continue the inspection of the Work. Within three (3) working days of this declaration, the Owner will issue in writing, a list of excessive deficiencies found. Upon receipt of the Owners notice of excessive deficiencies the Contractor will have ten (10) working days to remove such deficiencies. If such deficiencies have not been corrected in the time frame herein specified the Owner can at its' option complete the Work. Any costs incurred by the Owner as a result of its' assuming the responsibilities of the Contractor in this regard will be deducted from any monies remaining to be paid to the Contractor. Should the costs associated with the Owner having to assume responsibility for the work to correct excessive deficiencies exceed the amount of funds remaining to be paid the Contractor shall be liable to the Owner for the difference.

### 1.7 RECORD DOCUMENT SUBMITTALS

- A. General: Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure, fire-resistant location. Provide access to record documents for the Architect's reference during normal working hours.
- All of the record documentation listed herein shall be provided by the Contractor in hard copy and digitally. Digital copies shall be provided by the Contractor in PDF format, and issued to the Owner via CD. Hard copy shall be provided by the Contractor in an 8-1/2" x 11" binder.**
- B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies from the Work as originally shown. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
- Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work.
  - Mark new information that is important to the Owner but was not shown on Contract Drawings or Shop Drawings.
  - Note related change-order numbers where applicable.
  - Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
- C. Record Specifications: Maintain one complete copy of the Project Manual, including addenda. Include with the Project Manual one copy of other written construction documents, such as Change Orders and modifications issued in printed form during construction.
- Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
  - Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
  - Note related record drawing information and Product Data.

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4. Upon completion of the Work, submit record Specifications to the Architect for the Owner's records.
- D. Record Product Data: Maintain one copy of each Product Data submittal. Note related Change Orders and markup of record drawings and Specifications.
1. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site and from the manufacturer's installation instructions and recommendations.
  2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
  3. Upon completion of markup, submit complete set of record Product Data to the Architect for the Owner's records.
- E. Record Sample Submitted: Immediately prior to Substantial Completion, the Contractor shall meet with the Architect and the Owner's personnel at the Project Site to determine which Samples are to be transmitted to the Owner for record purposes. Comply with the Owner's instructions regarding delivery to the Owner's Sample storage area.
- F. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to the Architect for the Owner's records.
- G. Maintenance Manuals: Organize operation and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual, heavy-duty, 2-inch (51-mm), 3-ring, vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information:
1. Emergency instructions.
  2. Spare parts list.
  3. Copies of warranties.
  4. Wiring diagrams.
  5. Recommended "turn-around" cycles.
  6. Inspection procedures.
  7. Shop Drawings and Product Data.
  8. Fixture lamping schedule.
- H. Roughing Drawings and Operating Manuals: Plumbing, HVAC, electrical and other machinery and mechanical equipment items requiring utility service connections shall have their respective shop drawings accompanied by manufacturer's certified roughing drawings indicating accurate locations and sizes of all service utility connections.
- I. Sleeve and Opening Drawings: Prior to installing service utilities or other piping, etc. through structural elements of the building, the contractor shall prepare and submit accurate dimensioned drawings to the Construction Manager for approval of the Architect and/or Structural Engineer for approval indicating the positions and sizes of all sleeves and openings required to accommodate his/her work and installation of his/her piping, equipment, etc. and all with reference to the established dimensional grid of the building. Such drawings must be submitted in sufficient time to allow proper coordination with

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reinforcing steel shop drawings and proper placing in the field.

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- J. Control Valve and Circuit Location Charts and Diagrams: The contractor shall prepare a complete set of inked or typewritten control valve and circuit location diagrams, charts, diagrams and lists under frame glass in appropriate designed equipment rooms as directed. The contractor shall also furnish one-line diagrams as well as such color-coding of piping and wiring and identifying charges as specified or required. This information is to be framed under glass and installed where directed. The Contractor shall also provide the University a second complete set of the control valve and circuit location diagrams, charts, diagrams and lists not under glass.
- K. Warranties:
1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within the (10) days after completion of the applicable item of work. Leave the date of beginning of time of warranty until the Date of Final Acceptance of the building and prior to receipt of final payment.
  2. Make other submittals within ten (10) days after Date of Substantial Completion, prior to final Application for Payment.
  3. For items of Work for which acceptance is delayed beyond the Date of Substantial Completion, submit within (10) days after written acceptance, listing the date of acceptance as the beginning of the warranty period. Final payment will not be approved until the Owner has received all warranties.
  4. Warranty periods for all items installed as part of the Work under this Contract will start at 'Final Acceptance' of the entire scope of Work on the Project.
  5. Co-execute submittals when required.
  6. Warranty Manual: Bind all warranties and bonds in a commercial type 8 1/2" X 11" three D side ring binder with durable plastic covers.
    - a. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of General Contractor and equipment suppliers; and name of responsible company principal.
    - b. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of the product or work item.
    - c. Transmit two (2) copies of the "Warranties Manual" to the University prior to submission of Final Application for Payment.
  7. A certificate of Asbestos shall certify that no asbestos or asbestos-containing products are or have been installed as part of this project.

### 1.8 CLOSEOUT PROCEDURES

- A. Operation and Maintenance Instructions: Arrange for each Installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:
1. Maintenance manuals.
  2. Record documents.
  3. Spare parts and materials.
  4. Tools.
  5. Lubricants.

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6. Fuels.
  7. Identification systems.
  8. Control sequences.
  9. Hazards.
  10. Cleaning.
  11. Warranties and bonds.
  12. Maintenance agreements and similar continuing commitments.
- B. As part of instruction for operating equipment, demonstrate the following procedures:
1. Startup.
  2. Shutdown.
  3. Emergency operations.
  4. Noise and vibration adjustments.
  5. Safety procedures.
  6. Economy and efficiency adjustments.
  7. Effective energy utilization.
- C. Allow a minimum of three (3) hours training for all of the Owners personnel who will be involved with the maintenance or operation for each piece of equipment or system that requires any type of maintenance or operation.
- D. For equipment, or component parts of equipment put into service during construction and operated by the Owner, submit completed documents within ten (10) days after written acceptance and prior to receipt of final payment.
- E. The contractor shall submit the as-built documents to the Owner's Project Manager for review by the Architect/Engineer whether altered or not with a certification as to the accuracy of the information thereon at the time of contract completion and before final payment will be made to the contractor. After acceptance by the Architect/Engineer, the contractor will furnish two (2) sets of all shop and/or erection drawings used for as-built documentation.
1. All as-built drawings as submitted by the contractor shall be labeled "as-built" and dated above the title block. This information shall be checked, edited and certified by the Architect/Engineer who shall then transpose such information from the contractor's as-built drawings to the original tracings and certify that such tracing reflect "as-built" status and deliver said tracings to the University. Where shop drawings have been used by the contractor for as-built documentation the tracing provided shall include cross-reference information, which shall be included in the set of as-built drawings furnished to the University. The Contractor shall be responsible for and shall pay for the cost of erasable transparencies for its as-built drawings.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

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

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### PART 3 - EXECUTION

#### 3.1 FINAL CLEANING

- A. General: The General Conditions require general cleaning during construction. Regular site cleaning is included in Division 01 Section "Construction Facilities and Temporary Controls."
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion.
    - a. Remove labels that are not permanent labels.
    - b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are vision-detracting materials. Replace chipped or broken glass and other damaged transparent materials.
      - 1) removal of putty stains from glass and mirrors; wash and polish inside and outside;
    - c. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition. Leave concrete floors broom clean and dust free. Vacuum carpeted surfaces.
      - 1) removal of spots, paint and soil from resilient, glaze and unglazed masonry and ceramic flooring and wall work;
    - d. Vacuum as required and advisable and wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps to a mark free condition.
    - e. Clean the site, including landscape development areas, of rubbish, litter, and other foreign substances. Sweep paved areas broom clean; remove stains, spills, mud, stones and other foreign deposits. Rake grounds that are neither paved nor planted to a smooth, even-textured surface.
      - 1) restoration of all landscaping, roadway and walkways to pre-existing condition; damage to trees and plantings shall be repaired in the next planting season and such shall be guaranteed for one (1) year from date of repair and/or replanting;
    - f. removal of marks, undesirable stains, fingerprints, other soil, dust or dirt from painted, decorated or stained woodwork, plaster or plasterboard, metal acoustic tile and equipment surfaces;
    - g. removal of temporary floor protections; clean, wash or otherwise treat and/or polish all finished floors as directed;
    - h. clean exterior and interior metal surfaces, including doors and window frames and hardware, of oil stains, dust, dirt, paint and the like; polish where applicable and leave without fingerprints or blemishes;

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- i. removal of all pollutants of any kind or nature deposited or remaining upon the site or upon the University's property as a result of the construction work on this project;
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests.
- D. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.
- E. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of lawfully.
- 1. Where extra materials of value remain after completion of associated Work, they become the Owner's property. Dispose of these materials as directed by the Owner.

END OF SECTION 017700

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### SECTION 017820 - OPERATION AND MAINTENANCE DATA

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 SUMMARY

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the operation and maintenance data as specified herein.
- B. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory.
  - 2. Emergency manuals.
  - 3. Operation manuals for systems, subsystems, and equipment.
  - 4. Maintenance manuals for the care and maintenance of products, materials, and finishes systems and equipment.
- C. Related Sections include the following:
  - 1. Division 01 Section "Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
  - 2. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
  - 3. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
  - 4. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
  - 5. Divisions 02 through 48 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

##### 1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

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### 1.4 SUBMITTALS

- A. Initial Submittal: Submit two (2) draft copies of each manual at least fifteen (15) calendar days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Owner will return one copy of draft and mark whether general scope and content of manual are acceptable.
  - 1. In lieu of hard copies, Contractor may submit digital copies in PDF format.
- B. Final Submittal: Submit two copies of each manual in final form at least fifteen (15) calendar days before final inspection. Architect will return copy with comments within 15 days after final inspection.
  - 1. Submit four (4) sets prior to final inspection, bound in 8-1/2" X 11" binders with durable plastic covers, acceptable to the Owner.
  - 2. In addition, Contractor shall submit digital copy in PDF format.
  - 3. Submit final volumes revised, to the authorized representative of the Owner as required in these Contract Documents.

### 1.5 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

## PART 2 - PRODUCTS

### 2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
  - 1. List of documents.
  - 2. List of systems.
  - 3. List of equipment.
  - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

### 2.2 MANUALS, GENERAL

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- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
  2. Table of contents.
  3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
1. Subject matter included in manual.
  2. Name and address of Project.
  3. Name and address of Owner.
  4. Date of submittal.
  5. Name, address, and telephone number of Contractor.
  6. Name and address of Architect.
  7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
  2. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets. These manuals shall include a complete description of all systems and equipment, diagrams indicating connectors, oiling requirements, types of lubricants to be used and method of operating equipment. Included within the manuals shall be a list of names, addresses and telephone numbers of sub-contractors involved in the installation and firms capable of performing services for each mechanical item.
  3. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual. Internally subdivide the binders contents

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with permanent page dividers, logically organized as described below and with tab titling clearly printed under reinforced laminated plastic tabs.

- a. PART 1: Directory, listing names, addresses, contact persons and telephone numbers of Architects, Engineers, Contractors, Subcontractors and suppliers.
  - b. PART 2: Maintenance instructions subdivided by MasterSpec Format Sections as listed within these Contract Documents. For each Section identify names, addresses, contact persons and telephone numbers of Subcontractors and suppliers. Identify the following (in addition to the items listed in “G” above):
    - 1) Significant design criteria
    - 2) List of equipment.
    - 3) Parts list for each component.
    - 4) Maintenance instructions for equipment and systems.
    - 5) Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
4. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
  5. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
  6. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

### 2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
  1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
  1. Fire.
  2. Flood.
  3. Gas leak.
  4. Water leak.
  5. Power failure.
  6. Water outage.
  7. System, subsystem, or equipment failure.
  8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages,

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and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

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- D. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
  2. Shutdown instructions for each type of emergency.
  3. Operating instructions for conditions outside normal operating limits.
  4. Required sequences for electric or electronic systems.
  5. Special operating instructions and procedures.

### 2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.
  2. Performance and design criteria if Contractor is delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.
  9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

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### 2.5 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

### 2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

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- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard printed maintenance instructions and bulletins.
  2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  3. Identification and nomenclature of parts and components.
  4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Precautions against improper maintenance.
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
  6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts, Extra Materials and Maintenance Materials
1. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections. If there are no quantities specified then provide a minimum of five percent (5%) of:
    - a. all interior finish materials (attic stock).
    - b. the number of lamps and ballast needed for every light fixture.
    - c. the total number of automatic light sensors
    - d. the total number of each filter type required for each Mechanical Unit requiring filters.
  2. Provide 100% of all spare parts necessary to operate and maintain all equipment and building systems within the design parameters and/or as recommended by the manufacturer or supplier.
  3. Deliver to Owner's Project Manager and obtain receipt prior to final payment.
  4. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

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- G. Special Tools
  - 1. Provide any “special tools” (one of each type) if required as part of the operation and maintenance of any of the systems herein specified. “Special tools” are devices that are considered unique to a specified system and necessary for maintenance and operation of that system, and not normally part of the maintenance department inventory.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

### PART 3 - EXECUTION

#### 3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

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- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
  - 2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."
  
- G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017820

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### SECTION 018200 - DEMONSTRATION AND TRAINING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. In the event of any conflicts between the requirements of these Sections, the more stringent requirement shall apply.

##### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.
  - 3. Demonstration and training videotapes.
- B. Related Sections include the following, as applicable to this project:
  - 1. Division 01 Section "Allowances" for administrative and procedural requirements for demonstration and training allowances.
  - 2. Division 01 Section "Project Management and Coordination" for requirements for pre-instruction conferences.
  - 3. Divisions 02 through 48 Sections for specific requirements for demonstration and training for products in those Sections.
- C. Allowances: Furnish demonstration and training instruction time under the Demonstration and Training Allowance as specified in Division 01 Section "Allowances."
- D. Unit Price for Instruction Time: Length of instruction time will be measured by actual time spent performing demonstration and training in required location. No payment will be made for time spent assembling educational materials, setting up, or cleaning up.

##### 1.3 SUBMITTALS

- A. Instruction Program: Submit one (1) copy of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. At completion of training, submit one (1) complete training manual(s) for Owner's use.
- B. Qualification Data: For instructors.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.

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- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.
- E. Demonstration and Training Video w Transcript: Submit one (1) copy within seven (7) days of end of each training module.
  - 1. Identification: On each copy, provide an applied label with the following information:
    - a. Name of Project.
    - b. Name and address of photographer.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Date recorded.
    - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

### 1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Control Requirements," experienced in operation and maintenance procedures and training.
- C. Photographer Qualifications: A professional photographer who is experienced photographing construction projects.
- D. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
  - 1. Inspect and discuss locations and other facilities required for instruction.
  - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
  - 3. Review required content of instruction.
  - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

### 1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

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

### PART 2 - PRODUCTS

#### 2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
  - 1. Motorized doors, including overhead coiling doors, overhead coiling grilles, and automatic entrance doors.
  - 2. Equipment, including stage equipment, projection screens, loading dock equipment, waste compactors, food-service equipment, residential appliances and laboratory fume hoods, etc.
  - 3. Fire-protection systems, including fire alarm, fire pumps and fire-extinguishing systems.
  - 4. Intrusion detection systems.
  - 5. Conveying systems, including elevators, wheelchair lifts, escalators and cranes.
  - 6. Medical equipment, including medical gas equipment and piping.
  - 7. Laboratory equipment, including laboratory air and vacuum equipment and piping.
  - 8. Heat generation, including boilers, feed water equipment, pumps, steam distribution piping, and water distribution piping.
  - 9. Refrigeration systems, including chillers, cooling towers, condensers, pumps and distribution piping.
  - 10. HVAC systems, including air-handling equipment, air distribution systems and terminal equipment and devices.
  - 11. HVAC instrumentation and controls.
  - 12. Electrical service and distribution, including transformers, switchboards, panel boards, uninterruptible power supplies and motor controls.
  - 13. Packaged engine generators, including transfer switches.
  - 14. Lighting equipment and controls.
  - 15. Communication systems, including intercommunication, surveillance, clocks and programming, voice and data and television equipment.
  
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.

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2. Documentation: Review the following items in detail:
  - a. Emergency manuals.
  - b. Operations manuals.
  - c. Maintenance manuals.
  - d. Project Record Documents.
  - e. Identification systems.
  - f. Warranties and bonds.
  - g. Maintenance service agreements and similar continuing commitments.
  
3. Emergencies: Include the following, as applicable:
  - a. Instructions on meaning of warnings, trouble indications, and error messages.
  - b. Instructions on stopping.
  - c. Shutdown instructions for each type of emergency.
  - d. Operating instructions for conditions outside of normal operating limits.
  - e. Sequences for electric or electronic systems.
  - f. Special operating instructions and procedures.
  
4. Operations: Include the following, as applicable:
  - a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
  
5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
  
6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.



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7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
  
8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.
- B. Set up instructional equipment at instruction location.

#### 3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
  2. Owner will furnish an instructor to describe Owner's operational philosophy.
  3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  1. Schedule training with Owner with at least seven (7) calendar days' advance notice.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral and a demonstration performance-based test.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial

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training use.

### 3.3 DEMONSTRATION AND TRAINING VIDEOTAPES

- A. General: Engage a qualified commercial photographer to record demonstration and training video. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Recorded Format: MPG file to be provided to the Owner's Project Manager.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
- D. Narration: Describe scenes on recording by dubbing audio narration off-site after videotape is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.
- E. Transcript: Provide a typewritten transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

END OF SECTION 018200

## SECTION 024119 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

#### 1.2 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

#### 1.3 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Schedule of selective demolition activities with starting and ending dates for each activity.
- B. Predemolition photographs or video.
- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Inventory of items that have been removed and salvaged.

#### 1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

#### 1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
1. Before selective demolition, Owner will remove the following items:

- a. Books.
- b. Furniture.
  
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
  
- D. Storage or sale of removed items or materials on-site is not permitted.
  
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.
  
- F. Arrange selective demolition schedule so as not to interfere with Owner's operations.

## 1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
  
- B. Inventory and record the condition of items to be removed and salvaged.

### 3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

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

- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. Arrange to shut off utilities with utility companies.
  2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

### 3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- C. Remove temporary barricades and protections where hazards no longer exist.

### 3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

4. Maintain fire watch during and for at least 24 hours after flame-cutting operations.
  5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  6. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until delivery to Owner.
  4. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.6 CLEANING

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
1. Do not allow demolished materials to accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

## SECTION 033053 - MISCELLANEOUS CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 SUMMARY

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

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

### PART 2 - PRODUCTS

#### 2.1 CONCRETE, GENERAL

- A. Comply with ACI 301.

#### 2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

#### 2.3 CONCRETE MATERIALS

- A. Cementitious Materials:
  - 1. Portland Cement: ASTM C 150/C 150M, Type I.
  - 2. Fly Ash: ASTM C 618, Class C or F.
  - 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
- B. Normal-Weight Aggregate: ASTM C 33/C 33M, 1-1/2-inch nominal maximum aggregate size.
- C. Air-Entraining Admixture: ASTM C 260/C 260M.

- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- E. Water: ASTM C 94/C 94M.

## 2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

## 2.5 CONCRETE MIXTURES

- A. Normal-Weight Concrete:
  - 1. Minimum Compressive Strength: 3000 psi at 28 days.
  - 2. Slump Limit: 4 inches, plus or minus 1 inch.
  - 3. Air Content: Maintain within range permitted by ACI 301. Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

## 2.6 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
  - 1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 FORMWORK INSTALLATION

- A. Design, construct, erect, brace, and maintain formwork according to ACI 301.

### 3.2 EMBEDDED ITEM INSTALLATION

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



### 3.3 STEEL REINFORCEMENT INSTALLATION

- A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

### 3.4 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

### 3.5 CONCRETE PLACEMENT

- A. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- B. Do not add water to concrete during delivery, at Project site, or during placement.
- C. Consolidate concrete with mechanical vibrating equipment according to ACI 301.

### 3.6 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding 1/2 inch.
  - 1. Apply to concrete surfaces not exposed to public view.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.7 FINISHING UNFORMED SURFACES

- A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.
  - 1. Do not further disturb surfaces before starting finishing operations.

### 3.8 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.
- B. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

- C. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests: Perform according to ACI 301.
  - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
  - 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

END OF SECTION 033053

## SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

#### 1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Hydraulic cement underlayment.
2. Reinforcement.
3. Primer.
4. Surface sealer.

#### 1.4 QUALITY ASSURANCE

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F.

### PART 2 - PRODUCTS

#### 2.1 HYDRAULIC CEMENT UNDERLAYMENTS

- A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch and that can be feathered at edges to match adjacent floor elevations.

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. ARDEX Americas.
    - b. Custom Building Products.
    - c. Laticrete International, Inc.
    - d. MAPEI Corporation.
    - e. Maxxon Corporation.
    - f. USG Corporation.
  2. Cement Binder: ASTM C150/C150M, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C219.
  3. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109/C109M.
  4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.
- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.
1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- C. Water: Potable and at a temperature of not more than 70 deg F.
- D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.
- E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
- F. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare and clean substrate according to manufacturer's written instructions.
1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
  2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

- a. Anhydrous Calcium Chloride Test, ASTM F1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
- b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement, or as recommended by hydraulic cement underlayment manufacturer.

### 3.2 INSTALLATION

- A. Mix and install underlayment components according to manufacturer's written instructions.
  1. Close areas to traffic during underlayment installation and for time period after installation recommended in writing by manufacturer.
  2. Coordinate installation of components to provide optimum adhesion to substrate and between coats.
  3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Install underlayment to produce uniform, level surface.
  1. Install a final layer without aggregate to product surface.
  2. Feather edges to match adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during installation and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

### 3.3 INSTALLATION TOLERANCES

- A. Finish and measure surface, so gap at any point between gypsum cement underlayment surface and an unlevelled, freestanding, 10-foot- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch and 1/16 inch in 2 feet.

END OF SECTION 035416

## SECTION 054300 - SLOTTED CHANNEL FRAMING

### PART I – GENERAL

#### 1.01 SUMMARY

- A. Continuous slot, bolted metal framing channels and all associated fittings and hardware (Strut System).
- B. Strut System shall be used:
  - 1. To support electrical equipment and devices.
- C. Strut System and components must be supplied from a single approved Manufacturer.

#### 1.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, to design strut system, including attachment to building construction.

#### 1.03 QUALITY ASSURANCE

- B. MFMA Compliance: Comply with the latest revision of MFMA Standards Publication Number MFMA-3, "Metal Framing Standards Publication".
- C. NEC Compliance: Comply with the latest revision NFPA 70 - Article 352 "Surface Metal Raceways and Surface Nonmetallic Raceways".
- D. UL Compliance: Comply with UL "Standard for Surface Metal Raceway and Fittings", UL 5.
- E. Manufacturer's qualifications:
  - 1. The manufacturer shall have at least 10 years experience in manufacturing Strut Systems.
  - 2. The manufacturer must certify in writing all components supplied have been produced in accordance with an established quality assurance program.
- F. Work shall meet the requirements of the following standards:
  - 1. Federal, State and Local codes
  - 2. American Iron and Steel Institute (AISI) Specification for the Design of Cold- Formed Steel Structural Members 2001 Edition
  - 3. American Society for Testing And Materials (ASTM)
  - 4. Metal Framing Manufacturer's Association (MFMA)

#### 1.04 SUBMITTALS

- A. Structural calculations by a Registered Professional or Structural Engineer in the State of the Project's location for approval by the Professional of Record. Calculations may include, but are not limited to:

1. Description of design criteria
2. Stress and deflection analysis.
3. Selection of framing members, fittings, and accessories

- B. Assembly drawings necessary to install the Strut System in compliance with the Contract Drawings
- C. Pertinent manufacturers published data.

#### 1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All material is to be delivered to the work site in original factory packaging to avoid damage to the finish.
- B. Upon delivery to the work site, all components shall be protected from the elements by a shelter or other covering.

#### 1.06 WARRANTY

- A. Manufacturer shall warrant for 1 year from the shipment date that products will be free from defects in material or manufacture. In the event of any such defect in violation of the warranty, Manufacturer shall have the option to repair or replace any such defective product.
- B. Installer shall warrant for 1 year from the date of completion of work that the work will be free of defects in installation. In the event of any such defect in violation of the warranty, Installer shall have the option to repair or replace any such defective product.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Basis-of-Design Manufacturer: Strut systems to be installed shall be manufactured by Unistrut Corporation. Subject to compliance with requirements, other acceptable available manufacturers include:
  1. Cooper B-Line, Inc.

#### 2.02 ACCEPTABLE PRODUCT

- A. Basis-of-Design Product: P1000
  1. Strut shall be 1-5/8 inches wide in varying heights and welded combinations as required to meet load capacities and designs indicated on the drawings.

#### 2.03 MATERIALS

- A. All channel members shall be fabricated conforming to one of the following ASTM specifications:
  1. Plain Carbon Steel: A 1011 SS Grade 33
- B. All fittings shall be fabricated conforming to one of the following

ASTM specifications:

1. Carbon Steel: All carbon steel fittings shall be fabricated from steel that meets/exceeds the physical requirements of ASTM A1011 SS Grade 33 and conforms to one of the following ASTM specifications:
  - a. A 575
  - b. A 576
  - c. A 36
  - d. A 635
  - e. A 1059
  - f. A 1046

## 2.04 FINISHES

### A. Factory Painted

1. Channel.
  - a. Rust inhibiting thermoset acrylic enamel paint applied by electro-deposition after cleaning and phosphating, and thoroughlybaked.
2. Fittings and supports.
  - a. Polyester powder coat after cleaning and phosphating, and thoroughly baked.
3. Color shall be Black.

## 2.05 MOUNTING

- A. Minimum ½ inch threaded rod hangers at 4 feet on center, or more as determined by delegated design.
  - a. Channel

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. The installer shall inspect the work area prior to installation. If work area conditions are unsatisfactory, installation shall not proceed until satisfactory corrections are completed.

### 3.02 INSTALLATION

- A. Installation shall be accomplished by a fully trained manufacturer authorized installer.
- B. Set Strut System components into final position true to line, level and plumb, in accordance with approved drawings.
- C. Install with slotted channel facing the floor.
- D. Anchor material firmly in place, and tighten all connections to their recommended torques.



### 3.03 CLEANUP

- A. Upon completion of this section of work, remove all protective wraps and debris. Repair any damage due to installation of this section of work.

### 3.04 PROTECTION

- A. During installation, it shall be the responsibility of the installer to protect this work from damage.
- B. Upon completion of this scope of work, it shall become the responsibility of the general contractor to protect this work from damage during the remainder of construction on the project and until substantial completion.

END OF SECTION 054300

## SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Wood blocking and nailers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
1. Preservative-treated wood.
  2. Fire-retardant-treated wood.
  3. Power-driven fasteners.

### PART 2 - PRODUCTS

#### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
  2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
  3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

#### 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction not in contact with ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX).

- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat the following miscellaneous carpentry unless otherwise indicated.
  - 1. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.

### 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
  - 1. Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for all locations and where indicated.
  - 2. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841.
- B. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- C. Application: Treat all miscellaneous carpentry unless otherwise indicated including:
  - 1. Concealed blocking.

### 2.4 FASTENERS

- A. General: Provide fasteners that comply with requirements specified in this article for material and manufacture.
  - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

### 2.5 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Do not splice structural members between supports unless otherwise indicated.
- D. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- E. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

END OF SECTION 061053

## SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product, including panel products high-pressure decorative laminate adhesive for bonding plastic laminate and cabinet hardware and accessories.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- C. Samples:
1. Plastic laminates, for each color, pattern, and surface finish.
  2. Thermoset decorative panels, for each color, pattern, and surface finish.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

#### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

#### 1.5 FIELD CONDITIONS

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

## PART 2 - PRODUCTS

### 2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
- B. Grade: Custom.
- C. Type of Construction: Face frame.
- D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
- E. Reveal Dimension: 1/2 inch.
- F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
  - 1. Manufacturers: Subject to compliance with requirements, provide products indicated on drawings or comparable products by one of the following:
    - a. Formica Corporation.
    - b. Lamin-Art, Inc.
    - c. Panolam Industries International, Inc.
    - d. Wilsonart International; Div. of Premark International, Inc.
- G. Laminate Cladding for Exposed Surfaces:
  - 1. Horizontal Surfaces: Grade HGS.
  - 2. Postformed Surfaces: Grade HGP.
  - 3. Vertical Surfaces: Grade HGS.
  - 4. Pattern Direction: Vertically for doors and fixed panels, horizontally for drawer fronts.
- H. Materials for Semiexposed Surfaces:
  - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
  - 2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
  - 3. Drawer Bottoms: Thermoset decorative panels.
- I. Dust Panels: 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- J. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. Match Architect's sample.
    - a. Solid colors, matte finish.
    - b. Solid colors with core same color as surface, matte finish.
    - c. Wood grains, matte finish.
    - d. Patterns, matte finish.

## 2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
  - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
  - 1. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
  - 2. Softwood Plywood: DOC PS 1, medium-density overlay.
  - 3. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

## 2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.
- C. Wire Pulls: Richelieu Steel Pull 305, 5" Center to Center, Brushed Nickel or architect approved equal.
- D. Catches: Magnetic catches, BHMA A156.9, B03141.
- E. Shelf Rests: BHMA A156.9, B04013; metal.
- F. Drawer Slides: BHMA A156.9.
  - 1. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
  - 2. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
  - 3. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
- G. Door Locks: BHMA A156.11, E07121.
- H. Drawer Locks: BHMA A156.11, E07041.
- I. Door and Drawer Silencers: BHMA A156.16, L03011.
- J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
  - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

## 2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.
- D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
  - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.5 FABRICATION

- A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

### 3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Install cabinets 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.
- C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.



- E. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips, or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

END OF SECTION 064116

## SECTION 07 53 00 THERMOSET, EPDM, MEMBRANE ROOFING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Thermoset Membrane Roofing.
- B. Membrane Flashings.
- C. Metal Flashings.
- D. Roof Insulation.

#### 1.2 RELATED SECTIONS

- A. Section 05 36 00 - Composite Metal Decking.
- B. Section 06 10 00 - Rough Carpentry.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim.
- D. Section 22 30 00 - Plumbing Equipment.

#### 1.3 REFERENCES

- A. American Society of Civil Engineers (ASCE) - ASCE 7 - Minimum Design Loads for Buildings and Other Structures, Current Revision.
- B. ASTM International (ASTM):
  - 1. .
  - 2. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
  - 3. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
  - 4. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
  - 5. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
  - 6. ASTM D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
  - 7. ASTM D 816 - Standard Test Methods for Rubber Cements.
  - 8. ASTM D 4637 - Standard Specification for EPDM Sheet Used In Single-Ply Roof Membrane.
  - 9. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
- C. Factory Mutual (FM Global):
  - 1. Approval Guide.
    - a. Factory Mutual Standard 4470 - Approval Standard for Class 1 Roof Covers.
    - b. Loss Prevention Data Sheets 1-28, 1-29.
- D. International Code Council (ICC):

1. International Building Code (IBC).
- E. National Roofing Contractors Association (NRCA) - Low Slope Roofing and Waterproofing Manual, Current Edition.
- F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - Architectural Sheet Metal Manual.
- G. Underwriters Laboratories (UL):
  1. TGFU R1306 - "Roofing Systems and Materials Guide".
  2. UL-790 - Standard Test Method for Fire Tests of Roof Coverings.

#### 1.4 DESIGN CRITERIA

- A. Wind Uplift Performance:
  1. Roof system is designed to withstand wind uplift forces as calculated using the current revision of ASCE-7.
  2. Roof system is designed to achieve a FM 1 90 wind uplift rating.
  3. Warranted Wind Speed: 72 MPH.
- B. Fire Resistance Performance:
  1. Roof system will achieve a UL Class A rating when tested in accordance with UL-790.
- C. Thermal Performance: Roof system will achieve a minimum R value not less than 30.
- D. Drainage: Provide a roof system with positive drainage where all standing water dissipates within 48 hours after precipitation ends.
- E. Building Codes:
  1. Roof system will meet the requirements of all federal, state and local code bodies having jurisdiction.

#### 1.5 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Preparation instructions and recommendations.
  2. Storage and handling requirements and recommendations.
  3. Installation methods.
- B. Detail Drawings:
  1. Submit approved plan, section, elevation or isometric drawings which detail the appropriate methods for all flashing conditions found on the project.
  2. Coordinate approved drawings with locations found on the Contract Drawings.
- C. Selection Samples: For each finish product specified, two complete sets of chips representing manufacturer's full range of available colors, membranes, and thicknesses.
- D. Verification Samples: For each finish product specified, two samples, minimum size 4 inches (102 mm) square representing actual product, color, and patterns.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of fifteen (15) years experience.
- B. Installer Qualifications:

1. All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.
2. Installer shall be capable of extending the Manufacturer's Labor and Materials guarantee.
3. Installer shall be capable of extending the Manufacturer's No Dollar Limit guarantee.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.
- C. When loading materials onto the roof, comply with the requirements of Owner to prevent overloading and possible disturbance to the building structure.
- D. Contaminants such as grease, fats and oils shall not be allowed to come in direct contact with the roofing membrane.

#### 1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Refer to manufacturer's recommendations for general job site considerations.
- C. Safety Data Sheets (SDS) must be on location at all times during the transportation, storage and application of materials.
- D. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage.
- E. New roofing shall be complete and weathertight at the end of the work day.

#### 1.9 WARRANTY

- A. At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's Total-System warranty, outlining its terms, conditions, and exclusions from coverage.
  1. Duration: Twenty (20) years.
  2. Coverage to be extended to include roof edge metal water tightness in accordance with terms stated in the Warranty document.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis-of-Design Manufacturer: Versico Roofing Systems
- B. Substitutions: Subject to compliance with requirements, equivalent substitutions will be considered following the requirements of Divisioni 01.
- C.

## 2.2 SCOPE / APPLICATION

- A. Roof System: Provide a waterproof roof system, capable of withstanding uplift forces as specified in this section.
  - 1. Membrane Attachment: Fully Adhered.
- B. Base Flashing: Provide a waterproof, fully adhered base flashing system at all penetrations, plane transitions and terminations.
- C. Insulation: Provide a roof insulation system beneath the finish membrane.

## 2.3 INSULATION

- A. Polyisocyanurate MP-H: Versicore MPH (BOD). Rigid board with glass fiber reinforced (GRF) facers on both sides, meeting or exceeding the requirements of ASTM C 1289, Type II, Class 1.
  - 1. Compressive Strength: Grade 2 (20 psi) (Typical at exposed roofing).
  - 2. Compressive Strength: Grade 3 (25 psi) (At pavers).
  - 3. Density: 2 lb per cubic foot (24 kg per cu m) minimum.
- B. Water-resistant and silicone treated gypsum panel with embedded fiberglass facer on both sides. GP Gypsum Dens-Deck, distributed by Versico.
  - 1. Board Thickness: 5/8 inch (15 mm).

## 2.4 INSULATION ADHESIVE

- A. Flexible DASH Adhesive: A spray or extruded applied, two-component polyurethane, low-rise expanding foam adhesive used for attaching approved insulations to compatible substrates (concrete, cellular lightweight insulating concrete, gypsum, cementitious wood fiber, wood or steel) or existing smooth or gravel surfaced BUR, modified bitumen or cap sheets.

## 2.5 ETHYLENE, PROPYLENE, DIENE TERPOLYMER (EPDM) MEMBRANE

- A. VersiGard Non-Reinforced Membrane (BOD): Cured, non-reinforced EPDM membrane meeting the requirements of ASTM D 4637 Type I. (Typical for roof under pavers)
  - 1. Attachment Method: Fully Adhered.
  - 2. Color: Black (for roofing under pavers).
  - 3. Membrane Thickness: 90 mil (2.3 mm) nominal for roofing under paver areas.
  - 4. Sheet Dimensions:
  - 5. Width: 10 feet (3.05 m) maximum.
  - 6. Width: 16.5 feet (5.0 m) maximum.
  - 7. .
  - 8. Length: 100 feet (30.5 m) maximum.
  - 9. Performance:
    - a. Tensile Strength: 1550 psi (10.7 MPa) minimum (black).
    - b. Tear Resistance: 200 lbf per in (35 kN per m) minimum.
    - c. Elongation: 480 percent.
- B. VersiGard White Non-Reinforced Membrane (BOD): Cured, non-reinforced EPDM membrane meeting the requirements of ASTM D 4637 Type I (Typical for exposed roofs).
  - 1. Attachment Method: Fully Adhered.
  - 2. Color: White on Black.
  - 3. Membrane Thickness: 60 mil (1.5 mm) nominal.
  - 4. Width: 10 feet (3.05 m) maximum.

5. Width: 16.5 feet (5.0 m) maximum.
6. Performance:
  - a. Tensile Strength: 1685 psi (11.6 MPa) minimum.
  - b. Tear Resistance: 200 lbf per in (35 kN per m) minimum.
  - c. Elongation: 480 percent.

## 2.6 FLASHING ACCESSORIES

- A. Black or White QA Molded Pipe Seals: Factory applied QA tape on the deck flange, for use with VersiGard Black or White Roofing Systems.
- B. Pourable Sealer Pocket: Pre-fabricated Pourable Sealer Pocket consisting of a 2 inch (51 mm) wide plastic support strip with pre-applied, adhesive backed uncured EPDM Flashing.
- C. QA Inside/Outside Corner: A 7 inch by 9 inch (178 x 229 mm) precut 60-mil thick Uncured EPDM Flashing with a 30-mil (0.76 mm) pre-applied adhesive tape. Available in black and white.
- D. 20 Inch Quick-Applied Cured Flashing: A 20 inch wide (508 mm) cured EPDM membrane with QA Seam TAPE the full width, factory applied, used to flash curbs/skylights, etc.
- E. Quick-Applied Overlayment Strip: A nominal 40-mil (1.1 mm) black, semi-cured EPDM membrane laminated to a nominal 30-mil (0.76 mm) fully cured, pressure-sensitive adhesive for flashing gravel stops, metal edgings and Seam Fastening Plates.
- F. QA Coverstrip: A nominal 40-mil (1.1 mm) black, semi-cured EPDM membrane laminated to a nominal 30-mil (0.76 mm) cured, pre-applied adhesive tape for flashing gravel stops, metal edgings and Seam Fastening Plates.
- G. QA "T" Joint Covers: A factory cut 6 inch by 6 inch (152 mm x 152 mm) or 12 inch by 12 inch (304 mm x 304 mm) uncured 40-mil thick EPDM flashing laminated to a nominal 30-mil (0.76 mm) pre-applied adhesive tape, used to overlay field splice intersections and to cover field splices at angle changes.
- H. Clean Cured Flashing: A cleaned, cured .060 inch (1.5 mm) thick non-reinforced (seamless) black EPDM membrane used to flash gravel stops, metal edgings, walls/curbs and Seam Fastening Plates used for additional membrane securement when the use of RTS is not feasible.
- I. White Cured Flashing: A cured .060 inch (1.5 mm) thick non-reinforced (seamless) white-on-black EPDM membrane used to flash gravel stops, metal edgings, walls/curbs and Seam Fastening Plates used for additional membrane securement when the use of RTS is not feasible.
- J. Uncured EPDM Flashing: Formable 60-mil (1.5 mm) thick VersiGard uncured EPDM flashing.
- K. QA Uncured EPDM Flashing: 60-mil (1.5 mm) thick uncured EPDM Flashing laminated to a 30-mil (0.76 mm) pre-applied adhesive tape used in conjunction with VersiGard Primer as an option to VersiGard Uncured EPDM Flashing.

## 2.7 CLEANERS, PRIMERS, ADHESIVES AND SEALANTS

- A. Weathered Membrane Cleaner: Clear, solvent-based cleaner used to loosen and remove contaminants from the surface of exposed EPDM membrane prior to the application of Seam Adhesive or EPDM Primer.

- B. Lap Sealant: A black, heavy-bodied material (trowel or gun-consistency) used to seal the exposed edges of a membrane splice. A pre-formed Lap Sealant tool is included in each carton of Lap Sealant.
  - 1. Versico Lap Sealant: Black sealant for use with VersiGard Roofing Systems.
  - 2. White Lap Sealant: White sealant for use with White Roofing Systems.
- C. Versico QA Seam Tape: 3 inch (76 mm) or 6 inch (152 mm) wide by 100 foot (30.5 M) long splice tape used for splicing adjoining sections of EPDM membrane. Complies with the South Coast Air Quality Management District Rule 1168.
- D. Peel & Stick White Seam Tape: A 3 inch (76 mm) wide by 100 foot (30.5 M) long, cream colored splice tape used with White Systems. Complies with the South Coast Air Quality Management District Rule 1168.
- E. Low VOC EPDM Primer: a solvent based primer designed for one-step cleaning and priming of EPDM surfaces prior to installation of quick-applied products. This product complies with the less than 250 g per L VOC content requirements for the OTC Model Rule for Single-Ply Roofing Adhesives.
- F. Low-VOC Bonding Adhesive: a solvent-based contact adhesive that allows bonding to EPDM to various porous and non-porous substrates. This product complies with the less than 250 g per L VOC content requirements for the OTC Model Rule for Single-Ply Roofing Adhesives. This product does not comply with the following California counties' VOC regulations: Alameda, Contra Costa, El Dorado, Los Angeles, Marin, Napa, Orange, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, San Mateo, Santa Clara, Solano, Sonoma and Tehema.
- G. Water Cut-Off Mastic: A one-component, low viscosity, self wetting, Butyl blend mastic used as a compression sealing agent between EPDM membranes or uncured flashing and applicable substrates.
- H. One-Part Pourable Sealer: A black, one-component, moisture curing, elastomeric polyether sealant used for attaching lightning rod bases and ground cable clips to the membrane surface and as a sealant around hard-to-flash penetrations such as clusters of pipes.
- I. Universal Single-Ply Sealant: A 100 percent solids, solvent free, one-part, polyether sealant that provides a weather tight sealant to a variety of building substrates; used as a termination bar sealant. Available in white only.
- J. CAV-GRIP 3V Low-VOC Aerosol Contact Adhesive/Primer: a low-VOC, methylene chloride-free adhesive that can be used for a variety of applications including: Priming unexposed asphalt prior to applying Flexible DASH Adhesive, adhering VersiGard EPDM, horizontally, for the field of the roof and to vertical walls. Coverage rate is approximately 2,000-2,500 sq. ft. (186 to 232 square meters) per 40 lb (18 kg) cylinder and 4,000-5,000 sq. ft. (372 to 465 square meters) per 85 lb (39 kg) cylinder as a primer, in a single-sided application and 750 sq. ft. (70 square meters) per 40 lb (18 kg) cylinder and 1,500 sq. ft. (139 square meters) per 85 lb (39 kg) cylinder as an adhesive for vertical walls, in a double-sided application; 1,000 sq. ft. (93 square meters) per 40 lb (18 kg) cylinder and 2,000 sq. ft. (186 square meters) per 85 lb (39 kg) cylinder as an adhesive, horizontally, for the field of the roof, in a double-sided application

## 2.8 FASTENING COMPONENTS

- 1. .
- B. QA RTS (Reinforced Termination Strip): 6 or 9 inch (152 or 229 mm) wide, nominal 45-mil

(1.1 mm) thick clean, cured, reinforced EPDM black membrane with 3 inch wide pre-applied adhesive tape laminated along one edge for the 6 inch wide RTS and along both edges for the 9 inch (229 mm) wide RTS. 9 inch (229 mm) wide QA RTS is utilized for perimeter membrane securement on VersiGard Mechanically Attached Roofing Systems.

1. 6 inch RTS: 6 inch (152 mm) wide, 100 foot long (30.5 M), strip of (black) reinforced EPDM membrane for additional membrane securement on Adhered, Ballasted, and Mechanically Attached Roofing Systems.
- C. Seam Fastening Plate: 2 inch (51 mm) diameter metal fastening plate used for membrane and RTS attachment on Mechanically Attached Roofing Systems over wood or structural concrete decks. Seam Fastening Plates are also used in conjunction with RTS or EPDM membrane for additional membrane securement on Adhered or Ballasted Roofing Systems. This plate may be used for insulation attachment on Mechanically Attached Roofing Systems.
- D. Versico Fasteners:
1. HPVX Fasteners: A heavy-duty No. 15 threaded fastener with a Phillips head used for adhered assemblies where increased pullout resistance is necessary for steel and wood decks.
  2. Term Bar Nail-In: A 1 1/4 inch (32 mm) long expansion anchor with threaded drive pin used for fastening VersiGard Termination Bar or Seam Fastening Plates to concrete, brick or block walls.

## 2.9 EDGINGS AND TERMINATIONS

- A. VersiTrim 2000: An anchor bar roof edge fascia system consisting of 0.100 inch (2.5 mm) thick extruded aluminum bar, corrosion resistant stainless steel fasteners and snap-on fascia cover.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Do not commence work until all other work trades have completed jobs that require them to traverse the deck on foot or with equipment.
- D. A vapor retarder / temporary roof may be applied to protect the inside of the structure prior to the roof system installation.

### 3.3 SUBSTRATE PREPARATION



- A. Structural Concrete Deck:
  - 1. Minimum deck thickness for structural concrete is 4 inches (102 mm).
  - 2. Allow roof deck to cure prior to application of the roofing system. Where curing is in question, evaluate surface moisture and deck's dryness with the ASTM D-4263 or hot bitumen test procedures.
  - 3. Repair cracks greater than 1/8 inch (3 mm) in width in accordance with the deck manufacturer's recommendations.
  - 4. Sumps for the roof drains shall be provided in the casting of the deck.
  - 5. Where insulation is to be adhered with hot asphalt, prime the deck with asphalt/concrete primer, ASTM D 41 at the rate of one gallon per 100 square feet (0.4 L per sq m). Allow the primer to dry prior to the application of the roofing system.
  
- B. Steel Deck:
  - 1. Metal decks shall be a minimum uncoated thickness of 22 gauge and have a G-90 galvanized finish on all panels.
  - 2. Decks shall comply with the gauge and span requirements in the current Factory Mutual Approval Guide and be installed in accordance with Loss Prevention Data Sheet 1-28 or specific FM approval.
  - 3. Remove any surface corrosion and repair severely corroded areas. Properly fasten loose or inadequately secured decking.

### 3.4 INSULATION - SYSTEM DESIGN

- A. Base Layer:
  - 1. Type: Densdeck Prime
  - 2. Thickness (in/mm): 5/8"
  - 3. Attachment Method: Flexible Dash Adhesive.
  
- B. Top Layer:
  - 1. Type: Versicore.
  - 2. Thickness (in/mm): 5.2".
  - 3. Attachment Method: Flexible Dash Adhesive.
  
- C. Tapered System:
  - 1. Type: Versicore.
  - 2. Field Slope: 1/4" inch per ft
  - 3. Sump Slope: \_\_\_\_\_ inch per ft
  - 4. Cricket Slope: \_\_\_\_\_ inch per ft
  - 5. Attachment Method: Flexible Dash Adhesive

### 3.5 INSULATION PLACEMENT

- A. Install insulation or membrane underlayment over the substrate with boards butted tightly together with no joints or gaps greater than 1/4 inch (6 mm). Stagger joints both horizontally and vertically if multiple layers are provided.
  
- B. Secure insulation to the substrate with the required mechanical fasteners or insulation adhesive in accordance with the manufacturer's current application guidelines.
  
- C. Do not install wet, damaged or warped insulation boards.
  
- D. Stagger joints in one direction unless joints are to be taped. Install insulation boards snug. Gaps between board joints shall not exceed 1/4 inch (6 mm). Fill all gaps in excess of 1/4 inch (6 mm) with same insulation material.

- E. Wood nailers shall be at least 3-1/2 inches (89 mm) wide or 1 inch (25 mm) wider than adjacent metal flange. Thickness shall equal that of insulation but not less than 1 inch (25 mm) thickness.
- F. Miter and fill the edges of the insulation boards at ridges, valleys and other changes in plane to prevent open joints or irregular surfaces. Avoid breaking or crushing of the insulation at the corners.
- G. Do not install any more insulation than will be completely waterproofed each day.

### 3.6 INSULATION ATTACHMENT

- A. Securely attach insulation to the roof deck for Adhered Systems. Attachment shall have been successfully tested to meet or exceed the calculated uplift pressure required by the International Building Code (ASCE-7) or ANSI/SPRI WD-1.
- B. Enhance the perimeter and corner areas in accordance with FM Loss Prevention Data Sheet 1-29.
- C. Install insulation layers applied with adhesive, coverage rate as necessary to achieve the specified attachment and uplift rating. Press each board firmly into place after adhesive develops strings when touched, typically 1-1/2 to 2 minutes after adhesive was applied, and roll with a weighted roller. Add temporary weight and use relief cuts to ensure boards are well adhered. Stagger the joints of additional layers by a minimum of 6 inches (152 mm).

### 3.7 MEMBRANE PLACEMENT AND ATTACHMENT (Fully Adhered)

- A. Unroll and position membrane without stretching. Allow the membrane to relax for approximately 1/2 hour before bonding. Fold the sheet back onto itself so half the underside of the membrane is exposed.
- B. Apply the Bonding Adhesive in accordance with the manufacturer's published instructions, to both the underside of the membrane and the substrate. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.
- C. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded half of the membrane sheet with a soft bristle push broom to achieve maximum contact.
- D. Fold back the unbonded half of the membrane sheet and repeat the bonding procedure.
- E. Install adjoining membrane sheets in the same manner, overlapping edges appropriately to provide for the minimum splice width. It is recommended that all splices be shingled to avoid bucking of water.
- F. When positioning membrane sheets, exercise care to locate all field splices away from low spots and out of drain sumps. All field splices should be shingled to prevent bucking of water.

### 3.8 MEMBRANE SPLICING (Tape Splice)

- A. Overlap adjacent sheets and mark a line 1/2 inch (13 mm) out from the top sheet.
- B. Fold the top sheet back and clean the dry splice area a minimum of 3 inches (76 mm) on both membrane sheets.
- C. Apply Primer to the mating surfaces with a scrub pad, at a rate of approximately 450 square

feet per gallon for a 3 inch (76 mm) wide seam, and allow to dry.

- D. Apply 3 inch (76 mm) wide Seam Tape to bottom sheet with the edge of the release film along the marked line. Press tape onto the sheet using hand pressure. Overlap tape roll ends a minimum of 1 inch (25 mm).
- E. Remove the release film and press the top sheet onto the tape using hand pressure.
- F. Roll the seam toward the splice edge with a 2 inch (51 mm) wide steel roller.
- G. Install QA "T" Joint Cover, a 6 inch wide (152 mm) section of QA Flashing or Non-QA Flashing over all field splice intersections. When using Non-QA Flashing, seal edges of flashing with Lap Sealant.
- H. The use of Lap Sealant with tape splices is optional except at tape overlaps and cut edges of reinforced membrane where Lap Sealant is required.

### 3.9 FLASHING

- A. Wall and curb flashing shall be cured EPDM membrane. Continue the deck membrane as wall flashing where practicable.
- B. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging/coping and roof drain applications.

### 3.10 WALKWAYS

- A. Install walkways at all traffic concentration points (such as roof hatches, access doors, rooftop ladders, etc.) and all locations as identified on the Contract Drawings.
- B. Adhere walkway pads to the EPDM membrane in accordance with the manufacturer's current application guidelines.

### 3.11 DAILY SEALS

- A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal shall be performed to temporarily close the membrane to prevent water infiltration.
- B. Use Pourable Sealer or other acceptable membrane seal in accordance with the manufacturer's requirements.

### 3.12 CLEAN UP

- A. Perform daily clean-up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris shall be disposed of in a legally acceptable manner.
- B. Prior to the manufacturer's inspection for warranty, the applicator shall perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

### 3.13 PROTECTION

- A. Provide protection, such as 3/4 inch (19 mm) thick plywood, for all roof areas exposed to traffic during construction. Plywood must be smooth and free of fasteners and splinters.
- B. Protect installed products until completion of project.

- C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

## SECTION 076200 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Formed sill sheet metal fabrications.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Elastomeric sealant.

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

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.

- C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.

- B. Sample warranty.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Special warranty.

## 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

## 1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 deg F , ambient; 180 deg F , material surfaces .

## 2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying stripable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
  - 1. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Color: As selected by Architect from manufacturer's full range .
  - 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

## 2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

## 2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
  - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

## 2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
  4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
  2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
  2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams:
1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
  3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

## 2.6 SHEET METAL FABRICATIONS

- A. Sill Flashing: Fabricate in maximum lengths possible. Furnish with 6-inch- wide, joint cover plates. Shop fabricate interior and exterior corners.



1. Fabricate from the following materials:
  - a. Aluminum: 0.050 inch thick.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF UNDERLAYMENT

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.
  1. Install in shingle fashion to shed water.
  2. Lap joints not less than 2 inches.

### 3.2 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
  1. Install fasteners, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder sealant.
  3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
  4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
  5. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
  7. Do not field cut sheet metal flashing and trim by torch.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
  1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
  1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
  2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
  3. Use lapped expansion joints only where indicated on Drawings.

- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws .
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
  - 1. Use sealant-filled joints unless otherwise indicated.
    - a. Embed hooked flanges of joint members not less than 1 inch into sealant.
    - b. Form joints to completely conceal sealant.
    - c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
    - d. Adjust setting proportionately for installation at higher ambient temperatures.
      - 1) Do not install sealant-type joints at temperatures below 40 deg F.
  - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

### 3.3 INSTALLATION TOLERANCES

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

### 3.4 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

### 3.5 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

## SECTION 077200 - ROOF ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Roof curbs.
  2. Equipment supports.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
- B. Shop Drawings: For roof accessories.

#### 1.3 INFORMATIONAL SUBMITTALS

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.5 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
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. AES Industries, Inc.
    - b. Conn-Fab Sales, Inc.
    - c. Greenheck Fan Corporation.

- d. LMCurbs.
  - e. Pate Company (The).
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch thick.
- 1. Finish: Baked enamel or powder coat .
  - 2. Color: As selected by Architect from manufacturer's full range .
- D. Construction:
- 1. Curb Profile: Manufacturer's standard compatible with roofing system.
  - 2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
  - 3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
  - 4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
  - 5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
  - 6. Nailer: Factory-installed wood nailer along top flange of curb , continuous around curb perimeter.
  - 7. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
  - 8. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

## 2.2 EQUIPMENT SUPPORTS

- A. Equipment Supports: Internally reinforced perimeter metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, and integrally formed structure-mounting flange at bottom.
- 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. AES Industries, Inc.
    - b. Conn-Fab Sales, Inc.
    - c. Greenheck Fan Corporation.
    - d. LMCurbs.
    - e. Pate Company (The).
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch thick.

1. Finish: Baked enamel or powder coat .
2. Color: As selected by Architect from manufacturer's full range .

D. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. Nailer: Factory-installed continuous wood nailers 3-1/2 inches wide on top flange of equipment supports , continuous around support perimeter.
3. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
4. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
5. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.

## 2.3 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.

1. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, AZ50 coated.

1. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

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

1. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

D. Aluminum Extrusions and Tubes: ASTM B221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

E. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.

F. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.

G. Steel Tube: ASTM A500/A500M, round tube.

H. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.

I. Steel Pipe: ASTM A53/A53M, galvanized.

## 2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B.
- C.
- D. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.
- E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWWA C2; not less than 1-1/2 inches thick.
- F. .
- G. Underlayment:
  - 1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
  - 2. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D4397.
  - 3. Slip Sheet: Building paper, 3 lb/100 sq. ft. minimum, rosin sized.
  - 4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
- H. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
- I. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- J. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- K. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- L. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
- C. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

### 3.2 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

## SECTION 078413 - PENETRATION FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Penetrations in fire-resistance-rated walls.
  2. Penetrations in horizontal assemblies.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

#### 1.3 ACTION SUBMITTALS

- A. Product data.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Listed system designs.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."



## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

#### A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test in accordance with testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
  - a. Penetration firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.
    - 1) UL in its online directory "Product iQ."
    - 2) FM Approvals in its "Approval Guide."

### 2.2 PENETRATION FIRESTOPPING SYSTEMS

#### A. Description: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems are to be compatible with one another, with the substrates forming openings, and with penetrating items if any.

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. 3M Building and Construction.
  - b. Hilti, Inc. (Basis-of-Design).
  - c. Tremco Incorporated.

#### B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: Not less than the fire-resistance rating of the wall penetrated.
2. Membrane Penetrations: Install recessed fixtures such that the required fire resistance will not be reduced.
3. Basis-of-Design for cables through gypsum wall assembly: W-L-3065.
4. Basis-of-Design for metal pipe or conduit through gypsum wall assembly: W-L-1297.
5. Basis-of-Design for plastic pipe through gypsum wall assembly: W-L-2128.

#### C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of the floor. The following floor penetrations do not require a T-rating:
  - a. Those within the cavity of a wall.
  - b. Floor drains within a concealed space.
3. Basis-of-Design for metal piping through concrete floors: C-AJ-1421.
4. Basis-of-Design for plastic pipe through concrete floors: C-AJ-2271.
5. Basis-of-Design for cables through concrete floors: C-AJ-3320.

6. Basis-of-Design for insulated metal pipe through concrete floors: C-BJ-5015.
  - 7.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, in accordance with ASTM E84.
  - E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF PENETRATION FIRESTOPPING SYSTEMS

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
  1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- D. Install fill materials by proven techniques to produce the following results:
  1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

#### 3.2 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
  1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. 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:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

### 3.3 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

## SECTION 079200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Latex joint sealants.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

#### 1.3 ACTION SUBMITTALS

- A. Product data.
- B. Samples: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-sealant schedule.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.
- B. Sample warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Warranty Documentation:
1. Manufacturers' special warranties.
  2. Installer's special warranties.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

## 1.7 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### 2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
  - 1. **Manufacturers:** Subject to compliance with requirements, undefined:
    - a. Pecora Corporation.
    - b. Sika Corporation - Building Components.
    - c. The Dow Chemical Company.

### 2.3 URETHANE JOINT SEALANTS

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

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
  - a. Pecora Corporation
  - b. Sika Corporation
  - c. Tremco Incorporated.

## 2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Pecora Corporation.
    - b. Sika Corporation - Building Components.
    - c. The Dow Chemical Company.
    - d. Tremco Incorporated.

## 2.5 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Pecora Corporation.
    - b. PPG Paints; PPG Industries, Inc.
    - c. Sherwin-Williams Company (The).
    - d. Tremco Incorporated.

## 2.6 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
  1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
    - a. Adfast.
    - b. Alcot Plastics Ltd.
    - c. Construction Foam Products; a division of Nomaco, Inc.
    - d. Master Builders Solutions; brand of MBCC Group.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) , and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or

by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
  - 4.
  - 5. Provide recessed joint configuration of recess depth in accordance with Figure 8C in ASTM C1193.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- H. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage



or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  - 1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
    - a. Extent of Testing: Test completed and cured sealant joints as follows:
      - 1) Perform 10 tests for the first 1000 ft. of joint length for each kind of sealant and joint substrate.
      - 2) Perform one test for each 1000 ft. of joint length thereafter or one test per each floor per elevation.
    - b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
      - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
    - c. Inspect tested joints and report on the following:
      - 1) Whether sealants filled joint cavities and are free of voids.
      - 2) Whether sealant dimensions and configurations comply with specified requirements.
      - 3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
    - d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
    - e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
  - 2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
- C. Prepare test and inspection reports.

### 3.4 JOINT-SEALANT SCHEDULE

Joint-sealant applications in this article represent only a limited number of examples; modify to suit Project. For projects with more than one kind or color of sealant for joint locations listed, copy paragraphs and create an additional set of requirements and products for each variation.

For each joint sealant scheduled, retain corresponding product requirements in Part 2 that reference sealant standards, specify product properties and, if required, name manufacturers and products.

If designations are retained in "Joint-Sealant Application" paragraphs below, insert number to complete designation. Coordinate with designations used on Drawings.

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Joints between louvers and concrete walls.

Insert type of joint sealant in "Joint Sealant" Subparagraph below; coordinate with Part 2. First option is example only.

- 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.

- B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Control and expansion joints in tile flooring.

Insert type of joint sealant in "Joint Sealant" Subparagraph below; coordinate with Part 2. First option is example only

- 2. Joint Sealant: Urethane, M, NS, 50, T, NT.

- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
  - 1. Joint Locations:
    - a. Control joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.

Insert type of joint sealant in "Joint Sealant" Subparagraph below; coordinate with Part 2. First option is example only.

- 2. Joint Sealant: Acrylic latex.

- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints in wet areas.

Insert type of joint sealant in "Joint Sealant" Subparagraph below; coordinate with Part 2. First option is example only

- 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.

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Rowan Project No. 77154

Renovations to Campbell Library  
PROJECT MANUAL

Kimmel Bogrette Architecture  
KBAS Project No. 21-008

END OF SECTION 079200

## SECTION 079219 - ACOUSTICAL JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Acoustical joint sealants.

#### 1.2 ACTION SUBMITTALS

- A. Product data.
- B. Samples: Manufacturer's color charts consisting of strips of cured sealants, showing full range of available colors for each product exposed to view.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Test and Evaluation Reports:
  - 1. Product test reports.
- B. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Warranty Documentation:
  - 1. Manufacturers' special warranties.
  - 2. Installer's special warranties.

#### 1.5 WARRANTY

- A. Installer's Special Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Manufacturer's Special Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: five (5) years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 ACOUSTICAL JOINT SEALANTS

- A. Acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies in accordance with ASTM E90.
- B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
  - 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. DAP Products Inc.
    - b. Hilti, Inc.
    - c. Pecora Corporation.
  - 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors .

### 2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

- B. Joint Priming: Prime joint substrates where recommended by acoustical joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

END OF SECTION 079219

## SECTION 081213 - HOLLOW METAL FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Interior custom hollow-metal frames.
2. Borrowed lites.

#### 1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, frame profiles, metal thicknesses, and wall opening conditions.
- C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

### 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. Ceco Door; AADG, Inc.; ASSA ABLOY.
  2. Curries, AADG, Inc.; ASSA ABLOY Group.
  3. Pioneer Industries; AADG, Inc.; ASSA ABLOY.
  4. Republic Doors and Frames; a Allegion brand.
  5. Steelcraft; Allegion plc.

## 2.2 PERFORMANCE REQUIREMENTS

### 2.3 CUSTOM HOLLOW-METAL FRAMES

#### A. Interior Frames: NAAMM-HMMA 861. .

1. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
2. Construction: Face welded .
3. Exposed Finish: Prime.

### 2.4 FRAME ANCHORS

#### A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

#### B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

#### C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

#### D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

### 2.5 MATERIALS

#### A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

#### B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

#### C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

#### D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

#### E. Power-Actuated Fasteners in Concrete: Fabricated from corrosion-resistant materials.

#### F. Glazing: Comply with requirements in Section 088000 "Glazing."



## 2.6 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
1. Sidelite Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
  2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
1. Reinforce frames to receive nontemplated, mortised, and surface-mounted door hardware.
  2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.
- C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  2. Provide fixed frame moldings on outside of exterior and on secure side of interior frames. Provide loose stops and moldings on inside of hollow-metal frames.
  3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
  4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions. Comply with SDI A250.11 .
- B. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
1. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
  2. Install frames with removable stops located on secure side of opening.

- C. Fire-Rated Openings: Install frames according to NFPA 80.
- D. Floor Anchors: Secure with postinstalled expansion anchors.
  - 1. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
- E. Solidly pack mineral-fiber insulation inside frames.
- F. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
- G. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
- H. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
  - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- I. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

### 3.2 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081213

## SECTION 081216 - ALUMINUM FRAMES

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Interior aluminum frames for doors installed in gypsum board partitions.
2. Interior aluminum frames for glazing installed in gypsum board partitions.
3. Interior aluminum doors.

## 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For aluminum frames:
  1. Include elevations, sections, and installation details for each wall-opening condition.
- C. Samples: For each exposed product and for each color and texture specified.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Alpha Aluminum Architectural Products.
  2. Frameworks.
  3. RACO Interiors.
  4. Wilson Partitions; a division of Arcadia Inc. – Basis-of-Design.

## 2.2 PERFORMANCE REQUIREMENTS

## 2.3 INTERIOR ALUMINUM DOORS, DOOR FRAMES, AND GLAZING FRAMES

- A. Aluminum Framing: ASTM B221, with alloy and temper required to suit structural and finish requirements, and not less than 0.062 inch thick.

- B. Door Frames: Extruded aluminum, reinforced for hinges, strikes, and closers.
- C. Glazing Frames: Extruded aluminum, for specified glass thickness.
- D. Trim: Extruded aluminum, not less than 0.062 inch thick; removable, snap-in casing trim glazing stops and door stops, without exposed fasteners.
  - 1. Trim Style: Basis-of-Design Wilson Partitions Series 500 2" trim.
- E. Doors:
  - 1. Manufacturer's standard, factory-assembled, 1-3/4-inch- thick, aluminum-framed door construction.
    - a. Door Operation: Swinging .
    - b. Stiles: Medium .
    - c. Rails: 6-inch top rail and 10-inch bottom rail.
- F. Door Finish: Clear-anodized aluminum .
- G. Frame and Trim Finish: Clear-anodized aluminum.

## 2.4 ACCESSORIES

- A. Fasteners: Aluminum, nonmagnetic, stainless steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.
- B. Door Silencers: Manufacturer's standard continuous mohair, wool pile, or vinyl seals in gray color.
- C. Glazing Gaskets: Manufacturer's standard extruded or molded rubber or plastic, to accommodate glazing thickness indicated; in gray.
- D. Glass: As specified in Section 088000 "Glazing."
- E. Door Hardware: As specified in Section 087100 "Door Hardware."

## 2.5 FABRICATION

- A. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted and mitered connections.
- B. Factory prepare aluminum frames to receive templated mortised hardware; include cutouts, reinforcements, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."

- C. Fabricate frames for glazing with removable stops to allow glazing replacement without dismantling frame.
  - 1. Locate removable stops on the inside of spaces accessed by keyed doors.
- D. Fabricate components to allow secure installation without exposed fasteners.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install aluminum frames plumb, rigid, properly aligned, and securely fastened in place; according to manufacturer's written instructions.
- B. Install frame components in the longest possible lengths with no piece less than 48 inches; components 96 inches or shorter shall be one piece.
- C. Glass: Install glass according to Section 088000 "Glazing" and aluminum-frame manufacturer's written instructions.
- D. Doors: Install doors aligned with frames and fitted with required hardware.
- E. Door Hardware: Install according to Section 087100 "Door Hardware" and aluminum-frame manufacturer's written instructions.

#### 3.2 ADJUSTING

- A. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended in writing by frame manufacturer and according to AAMA 609 and AAMA 610.
- B. Touch Up: Repair marred frame surfaces to blend inconspicuously with adjacent unrepaired surface so touchup is not visible from a distance of 48 inches as viewed by Architect. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION 081216

## SECTION 081416 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Wood door frames.
3. Factory finishing flush wood doors and frames.
4. Factory fitting flush wood doors to frames and factory machining for hardware.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers.
5. Door trim for openings.
6. Door frame construction.
7. Factory-machining criteria.
8. Factory- finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Clearances and undercuts.
7. Requirements for veneer matching.
8. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For factory-finished doors and factory-finished door frames.

#### 1.3 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

## 1.4 QUALITY ASSURANCE

- A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program .

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire protection ratings and temperature rise limits indicated based on testing at positive pressure in accordance with UL 10C or NFPA 252.
  - 1. Temperature Rise Limit: At vertical exit enclosures, 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.

### 2.2 FLUSH WOOD DOORS AND FRAMES, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with "Architectural Woodwork Standards."
  - 1. Provide labels and certificates from AWI certification program indicating that doors and frames comply with requirements of grades specified.
    - a. Contractor registers the Work under this Section with the AWI Quality Certification Program at [www.awiqcp.org](http://www.awiqcp.org) or by calling 855-345-0991.

### 2.3 SOLID-CORE, FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:
  - 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. Lambton Doors.
    - b. Masonite Architectural.
    - c. Oshkosh Door Company.
    - d. VT Industries, Inc.
  - 2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
  - 3. Architectural Woodwork Standards Grade: Custom.
  - 4. Faces: Single-ply wood veneer not less than 1/50 inch thick.
    - a. Species: White oak .
    - b. Cut: Rift cut.
    - c. Match between Veneer Leaves: Book match.
    - d. Assembly of Veneer Leaves on Door Faces: Balance Running match.
    - e. Pair and Set Match: Provide for doors hung in same opening.
    - f. Room Match:

- 1) Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.
- g. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Section 064216 "Flush Wood Paneling."
5. Exposed Vertical Edges: Same species as faces - Architectural Woodwork Standards edge Type A .
  - a. Fire Rated Single Doors: Provide edge construction with intumescent sealsconcealed by outer stile. Comply with specified requirements for exposed vertical edges.
  - b. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
    - 1) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.
6. Core for Non-Fire-Rated Doors:
  - a. ANSI A208.1, Grade LD-2 particleboard.
    - 1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
      - a)
      - b)
      - c)
    - 2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."
  - b. Glued wood stave.
  - c. WDMA I.S. 10 structural composite lumber.
    - 1) Screw Withdrawal, Face: 550 lbf .
    - 2) Screw Withdrawal, Edge: 550 lbf .
  - d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
7. Core for Fire-Rated Doors: As required to achieve fire protection rating indicated on Drawings.
  - a. Blocking for Mineral Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire protection rating indicated on Drawings as needed to eliminate through bolting hardware.
8. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

## 2.4 WOOD DOOR FRAMES

### A. Interior Door Frames:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Lambton Doors.
  - b. Masonite Architectural.
  - c. Oshkosh Door Company.
2. Architectural Woodwork Standards Grade: Custom.
3. Wood Species and Cut: Match species and cut indicated for wood doors unless otherwise indicated.
4. Species: White oak .
5. Cut: Rift cut/rift sawn.



6. Wood Moisture Content: 5 to 10 percent.
7. Profile: Double rabbet .
8. Construction: Solid lumber, fire-retardant particleboard, or fire-retardant medium density fiberboard (MDF) with veneered exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated on Drawings.

## 2.5 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
  1. Wood Species: Same species as door faces .
  2. Profile: Recessed tapered beads .
  3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Metal Frames for Lite Openings in Fire Rated Doors: Manufacturer's Standard frame formed of 0.040 inch thick cold rolled steel sheet with baked enamel of powder coated finish approved for use un doors of fire protection rating indicated on drawings.
- C. Metal Louvers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allegion plc.
    - b. ASSA ABLOY.
    - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    - d. L & L Louvers, Inc.
  2. Blade Type: Vision-proof, inverted V .
  3. Metal and Finish:
    - a. Hot-dip galvanized steel, 0.040 inch thick, with baked-enamel- or powder-coated finish.

## 2.6 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
  1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
- B. Factory machine doors for hardware that is not surface applied.
  1. Locate hardware to comply with DHI-WDHS-3.
  2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
  3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
  4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
- C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

## 2.7 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
  1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  2. Finish faces, all four edges, edges of cutouts, and mortises.
  3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
  1. Architectural Woodwork Standards Grade: Custom.
  2. Architectural Woodwork Standards System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
  3. Staining: As selected by Architect from manufacturer's full range .
  4. Sheen: Satin.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
  1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
  2. Anchor frames to anchors or blocking built in or directly attached to substrates.
    - a. Secure with countersunk, concealed fasteners and blind nailing.
    - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
      - 1) For factory-finished items, use filler matching finish of items being installed.
  3. Install fire rated doors and frames in accordance with NFPA 80..
- D. Job-Fitted Doors:
  1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
    - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
  2. Machine doors for hardware.
  3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

4. Clearances:
  - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
  - b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
  - c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
  - d. Comply with NFPA 80 for fire-rated doors.
5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### 3.2 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

## SECTION 083113 - ACCESS DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Access doors and frames.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of access door and frame and for each finish specified.
- C. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

#### 1.4 QUALITY ASSURANCE

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

#### 2.2 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Exposed Flanges :
  - 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. ACUDOR Products, Inc.
    - b. Babcock-Davis.
    - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    - d. Larsen's Manufacturing Company.
  - 2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
  - 3. Locations: Wall and ceiling .
  - 4. Uncoated Steel Sheet for Door: Nominal 0.060 inch , 16 gage , factory primed .
  - 5. Frame Material: Same material, thickness, and finish as door .

6. Latch and Lock: Cam latch, key operated with interior release.

## 2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

## 2.4 FABRICATION

- A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- C. Latch and Lock Hardware:
  1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
  2. Keys: Furnish two keys per lock and key all locks alike.
  3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087100 "Door Hardware."

## 2.5 FINISHES

- A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
  2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil for topcoat.
    - a. Color: As selected by Architect from full range of industry colors .

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

**SECTION 087100  
DOOR HARDWARE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Hardware for wood, aluminum, and hollow metal doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.
- D. Lock cylinders for doors with balance of hardware specified in other sections.
- E. Thresholds.
- F. Weatherstripping and gasketing.

**1.02 RELATED REQUIREMENTS**

- A. Section 081113 - Hollow Metal Doors and Frames.
- B. Section 081116 - Aluminum Doors and Frames.
- C. Section 081213 - Hollow Metal Frames.
- D. Section 081416 - Flush Wood Doors.
- E. Section 281000 - Access Control: Electronic access control devices.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. BHMA A156.1 - Standard for Butts and Hinges 2021.
- C. BHMA A156.2 - Bored and Preassembled Locks and Latches 2017.
- D. BHMA A156.3 - Exit Devices 2020.
- E. BHMA A156.4 - Door Controls - Closers 2019.
- F. BHMA A156.8 - Door Controls - Overhead Stops and Holders 2021.
- G. BHMA A156.16 - Auxiliary Hardware 2018.
- H. BHMA A156.18 - Materials and Finishes 2020.
- I. BHMA A156.21 - Thresholds 2019.
- J. BHMA A156.25 - Electrified Locking Devices 2018.
- K. BHMA A156.26 - Standard for Continuous Hinges 2021.
- L. BHMA A156.28 - Recommended Practices For Mechanical Keying Systems 2018.
- M. BHMA A156.115 - Hardware Preparation In Steel Doors And Steel Frames 2016.
- N. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames 2006.
- O. DHI (H&S) - Sequence and Format for the Hardware Schedule 2019.
- P. DHI (KSN) - Keying Systems and Nomenclature 2019.
- Q. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- R. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.

- S. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- T. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2022.
- U. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.
- V. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- B. Sequence installation to ensure facility services connections are achieved in an orderly and expeditious manner.
- C. Preinstallation Meeting: Convene a preinstallation meeting four weeks prior to commencing work of this section; require attendance by affected installers and the following:
  - 1. Architect.
  - 2. Installer's Architectural Hardware Consultant (AHC).
  - 3. Hardware Installer.
  - 4. Owner's Security Consultant.
- D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- E. Keying Requirements Meeting:

#### **1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- C. Shop Drawings - Door Hardware Schedule: A detailed listing that includes each item of hardware to be installed on each door.
  - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
  - 2. Comply with DHI (H&S) using door numbering scheme and hardware set numbers as indicated in Contract Documents.
    - a. Submit in vertical format.
  - 3. List groups and suffixes in proper sequence.
  - 4. Include complete description for each door listed.
  - 5. Include manufacturer's and product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
  - 6. Include account of abbreviations and symbols used in schedule.
- D. Shop Drawings - Electrified Door Hardware: Include diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
  - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).



2. Elevations: Include front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
  3. Diagrams: Include point-to-point wiring diagrams that show each device in door opening system with related colored wire connections to each device.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Supplier's qualification statement.
- I. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
1. Include manufacturer's parts lists and templates.
  2. Bitting List: List of combinations as furnished.
- J. Keying Schedule:
1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.
- K. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- L. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- M. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
  2. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

#### **1.06 QUALITY ASSURANCE**

- A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.
- D. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

#### **1.08 WARRANTY**

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

- B. Manufacturer Warranty: Provide manufacturer warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.
  - 1. Closers: Ten years, minimum.
  - 2. Exit Devices: Five years, minimum.
  - 3. Locksets and Cylinders: Ten years, minimum.

## **PART 2 PRODUCTS**

### **2.01 GENERAL REQUIREMENTS**

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Locks: Provide a lock for each door, unless it's indicated that lock is not required.
  - 1. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's Series. As indicated in hardware sets.
  - 2. Trim: Provide lever handle or pull trim on outside of each lock, unless otherwise indicated.
  - 3. Strikes:
    - a. Finish: To match lock or latch.
    - b. Curved-Lip Strikes: Provide as standard, with extended lip to protect frame, unless otherwise indicated.
    - c. Center Strike At Pairs of Doors: 7/8 inch (22.2 mm) lip.
- D. Closers:
  - 1. Provide door closer on each exterior door, unless otherwise indicated.
  - 2. Provide door closer on each fire-rated and smoke-rated door.
  - 3. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.
- E. Overhead Stops and Holders (Door Checks):
  - 1. Provide stop for every swinging door, unless otherwise indicated.
  - 2. Overhead Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop, unless otherwise indicated.
  - 3. Overhead stop is not required if a floor or wall stop has been specified for the door.
- F. Drip Guards: Provide at head of outswinging exterior doors unless protected by roof or canopy directly overhead.
- G. Thresholds:
  - 1. Exterior Applications: Provide at each exterior door, unless otherwise indicated.
- H. Smoke and Draft Control Seals:
  - 1. Provide gasketing for smoke and draft control doors that complies with local codes, requirements of assemblies tested in accordance with UL 1784.
- I. Weatherstripping and Gasketing:
  - 1. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated.
  - 2. Provide door bottom sweep on each exterior door, unless otherwise indicated.

- J. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.
- K. See Section 281000 for additional access control system requirements.
- L. Fasteners:
  - 1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
    - a. Aluminum fasteners are not permitted.
    - b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
  - 2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
    - a. Self-drilling (Tek) type screws are not permitted.
  - 3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
  - 4. Provide wall grip inserts for hollow wall construction.
  - 5. Fire-Resistance-Rated Applications: Comply with NFPA 80.
    - a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
    - b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

## 2.02 PERFORMANCE REQUIREMENTS

- A. Provide door hardware products that comply with the following requirements:
  - 1. Applicable provisions of federal, state, and local codes.
    - a. NFPA 101.
  - 2. Accessibility: ADA Standards and ICC A117.1.
  - 3. Fire-Resistance-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
  - 4. Hardware on Fire-Resistance-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
  - 5. Hardware for Smoke and Draft Control Doors: Provide door hardware that complies with local codes, and requirements of assemblies tested in accordance with UL 1784.
  - 6. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
  - 7. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
  - 8. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

## 2.03 HINGES

- A. Manufacturers: Conventional butt hinges.
  - 1. BEST; dormakaba Group:
  - 2. Mckinney.

3. Ives Hardware.
- B. Properties:
1. Butt Hinges: As applicable to each item specified.
    - a. Standard Weight Hinges: Minimum of two (2) permanently lubricated non-detachable bearings.
    - b. Heavy Weight Hinges: Minimum of four (4) permanently lubricated bearings on heavy weight hinges.
    - c. Template screw hole locations.
    - d. Bearings: Concealed fully hardened bearings.
    - e. UL 10C listed for fire-resistance-rated doors.
  2. Continuous Hinges: As applicable to each item specified.
  3. Manufacturers: Best Access, Roton , Select Hardware
    - a. Geared Continuous Hinges: As applicable to each item specified.
      - 1) Non-handed.
      - 2) Anti-spinning through-fastener.
      - 3) UL 10C listed for fire-resistance-rated doors.
        - (a) Metal Door Installation: Rated up to 90 minutes.
        - (b) Wood Door Installation: Rated up to 60 minutes.
      - 4) Sufficient size to permit door to swing 180 degrees
- C. Sizes: See Door Hardware Schedule.
1. Hinge Widths: As required to clear surrounding trim.
  2. Sufficient size to allow 180 degree swing of door.
- D. Finishes: See Door Hardware Schedule.
1. Fully polish hinges; front, back, and barrel.
- E. Grades:
1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
  2. Comply with BHMA A156.18 Materials and Finishes.
  3. Continuous Hinges: Comply with BHMA A156.26, Grade 1.
- F. Material: Base metal as indicated for each item by BHMA material and finish designation.
- G. Types:
1. Butt Hinges: Include full mortise hinges.
  2. Continuous Hinges: Include geared hinges.
- H. Options: As applicable to each item specified.
- I. Quantities:
1. Butt Hinges: Three (3) hinges per leaves up to 90 inches (2286 mm) in height. Add one (1) for each additional 30 inches (762 mm) in height or fraction thereof.
    - a. Hinge weight and size unless otherwise indicated in hardware sets:
      - 1) For doors up to 36 inches (914 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.134 inch (3.4 mm) and a minimum of 4-1/2 inches (114 mm) in height.

- 2) For doors from 36 inches (914 mm) wide up to 42 inches (1067 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.145 inch (3.7 mm) and a minimum of 4-1/2 inches (114 mm) in height.
  - 3) For doors from 42 inches (1067 mm) wide up to 48 inches (1219 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.180 inch (4.6 mm) and a minimum of 5 inches (127 mm) in height.
  - 4) For doors greater than 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.180 inch (4.6 mm) and a minimum of 5 inches (127 mm) in height.
2. Continuous Hinges: One per door leaf.
- J. Applications: At swinging doors.
1. Provide non-removable pins at out-swinging doors with locking hardware and all exterior doors.
- K. Products:
1. Butt Hinges:
    - a. Ball Bearing, Five (5) Knuckle.
  2. Continuous Hinges:
    - a. Aluminum geared hinges.

**2.04 BOLTS**

- A. Manufacturers:
1. Trimco:
  2. Hiawatha.
  3. Burns.
- B. Properties:
1. Dustproof Strikes: For bolting into floor, provide except at metal thresholds.
- C. Options:
1. Extension Bolts: In leading edge of door, one bolt into floor, one bolt into top of frame.
  2. Lever extensions: Provide for top bolt at oversized doors.

**2.05 EXIT DEVICES**

- A. Manufacturers:
1. Precision Apex 2000 Series
  2. Von Duprin XP98 Series
- B. Properties:
1. Actuation: Crossbar.
  2. Touchpads: 'T' style metal touchpads and rail assemblies with matching chassis covers end caps.
  3. Latch Bolts: Stainless steel deadlocking with 3/4 inch (19 mm) projection using latch bolt.
  4. Lever Design: Match project standard lockset trims.
  5. Cylinder: Include where cylinder dogging or locking trim is indicated.
  6. Strike as recommended by manufacturer for application indicated.
  7. Dogging:
    - a. Non-Fire-Resistance-Rated Devices: Cylinder 1/4 inch (6 mm) hex key dogging.

- b. Fire-Resistance-Rated Devices: Manual dogging not permitted.
- 8. Touch bar assembly on wide style exit devices to have a 1/4 inch (6.3 mm) clearance to allow for vision frames.
- 9. All exposed exit device components to be of architectural metals and “true” architectural finishes.
- 10. Handing: Field-reversible.
- 11. Fasteners on Back Side of Device Channel: Concealed - exposed fasteners not allowed.
- 12. Vertical Latch Assemblies' Operation: Gravity, without use of springs.
- C. Grades: Complying with BHMA A156.3, Grade 1.
  - 1. Provide exit devices tested and certified by UL or by a recognized independent laboratory for mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.
- D. Standards Compliance:
  - 1. UL Listed for Panic and Fire for Class II Circuitry.
  - 2. Provide UL (DIR) listed exit device assemblies for fire-resistance-rated doors.
  - 3. Comply with UL 10C.
- E. Code Compliance: As required by authorities having jurisdiction in the State in which the Project is located.
  - 1. Listed by UL as a Controlled Exit Device (FULA) and Special Locking Arrangements (FWAX) category.
- F. Options:
  - 1. Electrified Devices:
  - 2. Delayed Egress Devices: Manufacturer's standard for the application.
  - 3. Internally mounted switch used to signal other components.
  - 4. Internally mounted switch that monitors the position of the latchbolt.
  - 5. MLR: Motorized latch retraction.
- G. Products:
  - 1. 2000.

## 2.06 ELECTRIC STRIKES

- A. Manufacturers:
  - 1. RCI
  - 2. HES.
  - 3. Allegion.
- B. Properties:
  - 1. Provide UL 1034 compliant devices.
  - 2. Provide UL 10C compliant devices.
  - 3. Include transformer and rectifier as necessary for complete installation.
- C. Installation: Connect electric strikes into fire alarm where non-rated doors are scheduled to release with fire or sprinkler alarm condition.

## 2.07 LOCK CYLINDERS

- A. Manufacturers:
  - 1. BEST. No Substitution

- B. Material:
  - 1. Manufacturer's standard corrosion-resistant brass alloy.
- C. Types: As applicable to each item specified.
  - 1. Patented small format interchangeable core (SFIC) type cylinders, with seven pin cores.

## 2.08 CYLINDRICAL LOCKS

- A. Manufacturers:
  - 1. BEST 9K Series. No Substitution
- B. Properties:
  - 1. Mechanical Locks:
    - a. Fitting modified ANSI A115.2 door preparation.
    - b. Door Thickness Fit: 1-3/8 inches (35 mm) to 2-1/4 inches (57 mm) thick doors.
    - c. Construction: Hub, side plate, shrouded rose, locking pin to be a one-piece casting with a shrouded locking lug.
      - 1) Through-bolted anti-rotational studs.
    - d. Cast stainless steel latch retractor with roller bearings for exceptionally smooth operation and superior strength and durability.
    - e. Bored Hole: 2-1/8 inch (54 mm) diameter.
    - f. Backset: 2-3/4 inches (70 mm) unless otherwise indicated.
    - g. Latch: Single piece tail-piece construction.
      - 1) Latchbolt Throw: 9/16 inch (14.3 mm), minimum.
    - h. Cylinders:
      - 1) Cylinder Core Types: Locks capable of supporting manufacturers' cores, as applicable.
    - i. Lever Trim:
      - 1) Style: See Door Hardware Schedule.
      - 2) Outside Lever Sleeve: Seamless one-piece construction.
  - 2. Electrified Locks: Same properties as standard locks, and as follows:
    - a. Function: Electrically locked (Fail Safe) or unlocked (Fail Secure), as indicated for each lock in Door Hardware Schedule.
- C. Finishes: See Door Hardware Schedule.
  - 1. Core Faces: Match finish of lockset.
- D. Grades: Comply with BHMA A156.2, Grade 1, Series 4000, Operational Grade 1, Extra Heavy Duty.
- E. Material: Manufacturer's standard for specified lock.
- F. Products: Cylindrical locks, including mechanical and electrified types.
  - 1. 9K (Grade 1).

## 2.09 DOOR PULLS AND PUSH PLATES

- A. Manufacturers:
  - 1. Trimco
  - 2. Hiawatha.
  - 3. Burns.

- B. Material: Stainless steel, unless otherwise indicated.

## 2.10 CLOSERS

- A. Manufacturers:
1. BEST EHD9000 Series
  2. LCN 4040XP Series.
- B. Properties:
- C. Grades:
1. Closers: Comply with BHMA A156.4, Grade 1.
    - a. Underwriters Laboratories Compliance:
      - 1) Product Listing: UL (DIR) and ULC for use on fire-resistance-rated doors.
        - (a) UL 228 - Door Closers-Holders, With or Without Integral Smoke Detectors.
- D. Installation:
1. Mounting: Includes surface mounted installations.
  2. Mount closers on non-public side of door and stair side of stair doors unless otherwise noted in hardware sets.
  3. At outswinging exterior doors, mount closer on interior side of door.
  4. Provide adapter plates, shim spacers, and blade stop spacers as required by frame and door conditions.
  5. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

## 2.11 OVERHEAD STOPS AND HOLDERS

- A. Manufacturers:
1. Architectural Builders Hardware Mfg (ABH)
  2. Glynn Johnson
  3. Rixson
- B. Sizes: Manufacturer's standard for the application.
- C. Finishes:
1. Arms and Brackets: Zinc-plated.
- D. Grades: As applicable to item specified.
1. Comply with BHMA A156.8, Grade 1.

## 2.12 PROTECTION PLATES

- A. Manufacturers:
1. Trimco
  2. Hiawatha.
  3. Burns.
- B. Properties:
1. Plates:
    - a. Kick Plates: Provide along bottom edge of push side of every wood door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
      - 1) Size: 10 inches (254 mm) high by 2 inch (51 mm) less door width (LDW) on push side of door.



- b. Mop Plates: Provide along bottom edge of push side of doors to provide protection from cleaning liquids and equipment damage to door surface.
  - c. Edges: Beveled, on four (4) unless otherwise indicated.
- C. Grades: Comply with BHMA A156.6.
- D. Material: As indicated for each item by BHMA material and finish designation.
- 1. Metal Properties: Stainless steel.
    - a. Metal, Standard Duty: Thickness 0.050 inch (1.27 mm), minimum.
- E. Installation:
- 1. Fasteners: Countersunk screw fasteners

**2.13 STOPS AND HOLDERS**

- A. Manufacturers:
- 1. Trimco
  - 2. Hiawatha.
  - 3. Burns.
- B. General: Provide overhead stop/holder when wall or floor stop is not feasible.
- C. Grades:
- 1. Door Holders, Wall Bumpers, and Floor Stops: Comply with BHMA A156.16 and Resilient Material Retention Test as described in this standard.
- D. Types:

**2.14 THRESHOLDS**

- A. Manufacturers:
- 1. National Guard Products
  - 2. Pemko.
  - 3. Reese.
- B. Properties:
- 1. Threshold Surface: Fluted horizontal grooves across full width.
- C. Grades: Thresholds: Comply with BHMA A156.21.
- D. Material: Base metal as indicated for each item by BHMA material and finish designation.
- E. Types: As applicable to project conditions. Provide barrier-free type at every location where specified.
- 1. Saddle Thresholds: Without thermal break.
  - 2. Bumper Seal Thresholds with Gasket: Use silicone gaskets.

**2.15 WEATHERSTRIPPING AND GASKETING**

- A. Manufacturers:
- 1. National Guard Products, Inc: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
  - 2. Pemko .
  - 3. Reese.
- B. Products:
- 1. Weatherstripping: See Door Hardware Schedule.
  - 2. Smoke Seals: See Door Hardware Schedule.

3. Meeting Stile Seals: See Door Hardware Schedule.
4. Door Bottom Seals:
  - a. Door Sweeps: See Door Hardware Schedule.

## 2.16 KEYS AND CORES

- A. Manufacturers:
  1. BEST, No Substitution
- B. Properties: Complying with guidelines of BHMA A156.28.
  1. Provide small format interchangeable core.
  2. Provide Patented CORMAX keys and cores.
  3. Provide keying information in compliance with DHI (KSN) standards.
  4. Keying Schedule: Arrange for a keying meeting, with Architect, Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying complies with project requirements.
  5. Keying: Master keyed.
  6. Include construction keying and control keying with Brass removable core cylinders.
  7. Supply keys in following quantities:
    - a. Grand Master Keys: 2 each.
    - b. Master Keys: 4 each each group.
    - c. Construction Master Keys: 4 each.
    - d. Construction Control Keys: 2 each.
    - e. Perm Core Control Keys: 4 each.
    - f. Change Keys: 2 each change keys for each keyed core.
  8. Deliver keys with identifying tags to Owner by security shipment direct from manufacturer.
  9. Include installation of permanent cores and return construction cores to hardware supplier. Construction cores and keys to remain property of hardware supplier.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.
- B. Correct all defects prior to proceeding with installation.
- C. Verify that electric power is available to power operated devices and of correct characteristics.

### 3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Install hardware using the manufacturer's fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.
- C. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
- D. Install hardware for smoke and draft control doors in accordance with NFPA 105.
- E. Use templates provided by hardware item manufacturer.

- F. Do not install surface mounted items until application of finishes to substrate are fully completed.
- G. Wash down masonry walls and complete painting or staining of doors and frames.
- H. Complete finish flooring prior to installation of thresholds.
- I. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

**3.03 FIELD QUALITY CONTROL**

- A. Perform field inspection and testing under provisions of Section 014000 - Quality Requirements.

**3.04 CLEANING**

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation activities.

**3.05 PROTECTION**

- A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.
- B. Do not permit adjacent work to damage hardware or finish.

**END OF SECTION**

## Manufacturer List

<b>Code</b>	<b>Name</b>
AB	ABH Manufacturing Inc.
BE	Best Access Systems
BY	By Related Section
NA	National Guard
PR	BEST Precision Exit Devices
ST	BEST Hinges and Sliding
TR	Trimco
RC	RCI

## Option List

<b>Code</b>	<b>Description</b>
54	CONCEALED WIRES
7/8"LTC	7/8" Lip-To-Center Strike

Renovations to Campbell Library – Phase 1

Rowan University  
Rowan Project No. 77154

PROJECT MANUAL

Kimmel Bogrette Architecture  
KBAS Project No. 21-008

B4E-HEAVY-KP	BEVELED 4 EDGES - KICK PLATES
BSHD90	Blade Stop Spacer
C	QUICK CONNECT WIRING OPTION
CE	CONC/WIRE
CFC	CUT FOR CYLINDER
CSK	COUNTER SINKING OF KICK and MOP PLATES
CYLT	CUT FOR T-TURN
DP90	Drop Plate
EPT Prep	EPT Prep
FL	Fire Exit Hardware
FS	Fail Safe
LBR	LESS BOTTOM ROD
LD	Less Dogging
MLR	MOTORIZED LATCH RETRACTION
N	Thru-Bolt w/ Flow-Thru
NFHD90	Angled Narrow Frame Bracket - Painted
VIB	Double Visual Indicator Option

## Finish List

<b>Code</b>	<b>Description</b>
26D	Satin Chrome
626	Satin Chromium Plated
630	Satin Stainless Steel
689	Aluminum Painted
AL	Aluminum
GREY	Grey
US26D	Chromium Plated, Dull
US32D	Stainless Steel, Dull

## Hardware Sets

### Set #01 - Alum Lobby - Card Access – Auto Operator

Doors: 1/440A

1	Continuous Hinge	661HD UL EPT Prep	AL	ST
1	Continuous Hinge	661HD UL	AL	ST
1	Exit Device	C MLR 2203 LBR LD	630	PR
1	Exit Device	2201 LBR LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Door Pull	1191-4J N	630	TR
1	Closer	EHD9016 SPA90 BSHD90 DP90 NFHD90	689	BE
1	Auto Operator	PROVIDED BY SECTION 087113	689	BY
2	Overhead Stop	1020 SL Series	US32D	AB
1	Power Transfer	EPT-12C	630	PR
1	Power Supply	POWER SUPPLY BY OWNER'S SECURITY VENDOR		BY
1	Card Reader	CARD READER BY OWNER'S SECURITY VENDOR		BY
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
2	Door Position Switch	DPS BY OWNER'S SECURITY VENDOR		BY
1	Harness	WH-6E		ST
1	Harness	WH-192P		ST
1	Harness	WH-XXP (Length as Req'd)		ST
1	Square Push Plate	946HP475-MO See Section 087113	32D	RC
1	Mullion Push Plate	941HP-MO See Section 087113	32D	RC

NOTE: Balance of seals by Aluminum Frame/Door manufacturer. Coordinate door hardware with Aluminum Frame/Door manufacturer. Operation: Unlocked Hours - Doors closed and electrically dogged down by Access Control System allowing push / pull operation. Doors can be manually opened by door pulls or automatic operation by use of Rotunda side and Suite side actuators. Locked Hours - Doors closed and locked. Access Control System to disable outside actuator when doors are locked. Presenting valid credential to card reader signals latch bolts to retract and enables outside actuator to allow authorized entry by door pulls or automatic entry by pressing actuator button to signal automatic operator cycle to open the door. Suite side actuator signals retraction of exit device latch bolt before cycling automatic operator (Actuator always enabled). Free egress at all times. Mechanical key override. All wiring and conduit by electrical contractor. Coordinate wiring and installation with EC / GC / Security Vendor.

### Set #02 - Area

Doors: 1/L410

6	Butt Hinge	FBB168 4.5" x 4.5" NRP	26D	ST
1	Exit Device	2201 LBR LD	630	PR
1	Exit Device	2208 X 4908B LBR LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
2	Closer	EHD9016 SDS90 DP90	689	BE
2	Kick Plate	K0050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Gasketing	2525 C @ Head & Jamb		NA

DIVISION 08

DOOR HARDWARE

087100 - 15

Bidding

March 22, 2024

**Set #03 - Developer Area**

Doors: 1/440B

3	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Exit Device	2103 X 4903B LD	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	EHD9016 SDS90	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
3	Silencer	1229A	GREY	TR

**Set #04 - Meeting**

Doors: 1/440E

6	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Manual Flushbolt	3917 (Top Bolt)	626	TR
1	Classroom Lockset	9K3-7R16D PATD 7/8"LTC	626	BE
2	Wall Bumper	1270CX	626	TR
2	Silencer	1229A	GREY	TR

**Set #05 - Women's / Men's**

Doors: 1/L412, 2/L412

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Classroom Deadlock	48H-7R PATD	626	BE
1	Pull Plate	1014-3B CYLT	630	TR
1	Push Plate	1001-9 CFC	630	TR
1	Closer	EHD9016 AF90	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Mop Plate	KM050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA

**Set #06 - GN Toilet**

Doors: 1/425A

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Privacy Set	45H-OLT16H VIB	626	BE
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Mop Plate	KM050 10" x 1" LDW B4E-Heavy CSK	630	TR
1	Gasketing	2525 C @ Head & Jambs		NA

**Set #07 - Elec**

Doors: 1/445

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Storeroom Lockset	9K3-7D16D PATD	626	BE
1	Closer	EHD9016 AF90	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing	2525 C @ Head & Jambs		NA

**Set #08 - Storage**

Doors: 1/452

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Storeroom Lockset	9K3-7D16D PATD	626	BE
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

**Set #09 - Seminar, Server**

Doors: 1/428, 1/429, 1/446

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Wireless Lockset	WIRELESS LOCKSET BY OWNER'S SECURITY VENDOR	US26D	BY
1	Core	1CM PATD	626	BE
1	Closer	EHD9016 AF90	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

NOTE: Contact Bruce Pullen (609-610-4937) [bruce.pullen@secuni.com](mailto:bruce.pullen@secuni.com) for wireless product information and templating requirements for doors and frames. Low voltage wire node connection to be provided by GC.

**Set #09A - Classroom**

Doors: 1/441, 1/442

3	Butt Hinge	FBB179 4.5" x 4.5"	26D	ST
1	Wireless Lockset	WIRELESS LOCKSET BY OWNER'S SECURITY VENDOR	US26D	BY
1	Core	1CM PATD	626	BE
1	Closer	EHD9016 PH90	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

NOTE: Contact Bruce Pullen (609-610-4937) [bruce.pullen@secuni.com](mailto:bruce.pullen@secuni.com) for wireless product information and templating requirements for doors and frames. Low voltage wire node connection to be provided by GC.

**Set #10 - IT**

Doors: 1/411

3	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Wireless Lockset	WIRELESS LOCKSET BY OWNER'S SECURITY VENDOR	US26D	BY
1	Core	1CM PATD	626	BE
1	Closer	EHD9016 SDS90	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
3	Silencer	1229A	GREY	TR

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NOTE: Contact Bruce Pullen (609-610-4937) bruce.pullen@secuni.com for wireless product information and templating requirements for doors and frames. Low voltage wire node connection to be provided by GC.

**Set #11 - Stair HMD x Exist FR - Card Access**

Doors: 4/S1, 4/S2, 4/S4, 5/S1, 5/S2, 5/S3, 5/S4, 6/S1, 6/S2

2	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Butt Hinge	CE FBB179 4.5" x 4.5" NRP 54	26D	ST
1	Exit Device	FL E2103 X 4908B FS	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	EHD9016 SDS90	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Power Supply	POWER SUPPLY BY OWNER'S SECURITY VENDOR		BY
1	Card Reader	CARD READER BY OWNER'S SECURITY VENDOR		BY
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Door Position Switch	DPS BY OWNER'S SECURITY VENDOR		BY
1	Gasketing	2525 C @ Head & Jambs		NA

NOTE: Verify new hardware with existing frame. Patch, Prep and modify existing frame as required by GC. Fill or patch all remaining holes or preps to code compliant conditions. All modifications must comply with code requirements for fire rated doors / frames. Provide adequate fasteners for all applications. Operation: Door is normally closed and locked. Presenting valid credential at Stair side card reader releases secure lever allowing entry. Mechanical key bypass. Tied into building fire alarm system. In the event of power loss or activation of building fire alarm system, electrified trim of exit device to unlock allowing entry. Free egress at all times. All wiring and conduit by electrical contractor. Coordinate wiring and installation with EC / GC / Security Vendor.

**Set #12 – Closet Existing Opening**

Doors: 1/414, 1/416

1	Wireless Lockset	WIRELESS LOCKSET BY OWNER'S SECURITY VENDOR US26D		BY
1	Core	1CM PATD	626	BE
1	Closer	EHD9016 DS90	689	BE
1	Lock Wrap-Around	By Owner's Security Vendor		BY
3	Silencer	1229A	GREY	TR

NOTE: Verify new hardware with existing opening. Patch, Prep and modify existing Frame/Door as required by GC. Fill or patch all remaining holes or preps. Contact Bruce Pullen (609-610-4937) bruce.pullen@secuni.com for wireless product information and templating requirements for doors and frames. Low voltage wire node connection to be provided by GC.

**Set #13 – Study Existing Opening**

Doors: 1/H424B

1	Wireless Lockset	WIRELESS LOCKSET BY OWNER'S SECURITY VENDOR US26D		BY
1	Core	1CM PATD	626	BE
1	Closer	EHD9016 SPA90	689	BE



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1	Lock Wrap-Around	By Owner's Security Vendor		BY
3	Silencer	1229A	GREY	TR

NOTE: Verify new hardware with existing opening. Patch, Prep and modify existing Frame/Door as required by GC. Fill or patch all remaining holes or preps. Contact Bruce Pullen (609-610-4937) bruce.pullen@secuni.com for wireless product information and templating requirements for doors and frames. Low voltage wire node connection to be provided by GC.

**Set #14 – Hall**

Doors: 1/H424C

3	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Wireless Lockset	WIRELESS LOCKSET BY OWNER'S SECURITY VENDOR	US26D	BY
1	Core	1CM PATD	626	BE
1	Closer	EHD9016 SPA90	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Wall Bumper	1270CX	626	TR
3	Silencer	1229A	GREY	TR

NOTE: Contact Bruce Pullen (609-610-4937) bruce.pullen@secuni.com for wireless product information and templating requirements for doors and frames. Low voltage wire node connection to be provided by GC.

**Set #15 – Classroom Existing Opening**

Doors: 1/578

1	Wireless Lockset	WIRELESS LOCKSET BY OWNER'S SECURITY VENDOR	US26D	BY
1	Core	1CM PATD	626	BE
1	Closer	EHD9016 SPA90	689	BE
3	Silencer	1229A	GREY	TR

NOTE: Verify new hardware with existing opening. Patch, Prep and modify existing Frame/Door as required by GC. Fill or patch all remaining holes or preps. Contact Bruce Pullen (609-610-4937) bruce.pullen@secuni.com for wireless product information and templating requirements for doors and frames. Low voltage wire node connection to be provided by GC.

**Set #16 – Closet Existing Opening**

Doors: 1/522A

1	Wireless Lockset	WIRELESS LOCKSET BY OWNER'S SECURITY VENDOR	US26D	BY
1	Core	1CM PATD	626	BE
1	Closer	EHD9016 SDS90	689	BE
3	Silencer	1229A	GREY	TR

NOTE: Verify new hardware with existing opening. Patch, Prep and modify existing Frame/Door as required by GC. Fill or patch all remaining holes or preps. Contact Bruce Pullen (609-610-4937) bruce.pullen@secuni.com for wireless product information and templating requirements for doors and frames. Low voltage wire node connection to be provided by GC.

**Set #17 - Stair - Card Access**

Doors: 5/S4

2	Butt Hinge	FBB179 4.5" x 4.5" NRP	26D	ST
1	Butt Hinge	CE FBB179 4.5" x 4.5" NRP 54	26D	ST
1	Exit Device	FL E2103 X 4908B FS	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
1	Closer	EHD9016 SDS90	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E-Heavy CSK	630	TR
1	Power Supply	POWER SUPPLY BY OWNER'S SECURITY VENDOR		BY
1	Card Reader	CARD READER BY OWNER'S SECURITY VENDOR		BY
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Door Position Switch	DPS BY OWNER'S SECURITY VENDOR		BY
1	Gasketing	2525 C @ Head & Jamb		NA

NOTE: Operation: Door is normally closed and locked. Presenting valid credential at Stair side card reader releases secure lever allowing entry. Mechanical key bypass. Tied into building fire alarm system. In the event of power loss or activation of building fire alarm system, electrified trim of exit device to unlock allowing entry. Free egress at all times. All wiring and conduit by electrical contractor. Coordinate wiring and installation with EC / GC / Security Vendor.

**Set #18 – Roof Access Exist Opening - Card Access**

Doors: 1/550

1	Storeroom Lockset	9K3-7D16D PATD	626	BE
1	Elec Strike	F2164 F2LM	32B	RC
1	Power Supply	POWER SUPPLY BY OWNER'S SECURITY VENDOR		BY
1	Card Reader	CARD READER BY OWNER'S SECURITY VENDOR		BY
1	Wiring Diagram	WIRING DIAGRAM FURNISHED BY HWDE. SUPPLIER		BY
1	Door Position Switch	DPS BY OWNER'S SECURITY VENDOR		BY

NOTE: Verify new hardware with existing frame. Patch, Prep and modify existing frame as required by GC. Fill or patch all remaining holes or preps to code compliant conditions. All modifications must comply with code requirements for fire rated doors / frames. Provide adequate fasteners for all applications. Operation: Door is normally closed and locked. Presenting valid credential to card reader allows authorized entry. Mechanical key bypass. In the event of power loss Door remains closed and locked. Free egress at all times. All wiring and conduit by electrical contractor. Coordinate wiring and installation with EC / GC / Security Vendor.

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# Opening List

<b>Opening</b>	<b>Hdw Set</b>	<b>Opening Label</b>	<b>Door Type</b>	<b>Frame Type</b>
4/S1	11			
4/S2	11			
4/S4	11			
1/411	10			
1/414	12			
1/416	12			
1/428	09			
1/429	09			
1/441	09A			
1/442	09A			
1/445	07			
1/446	09			
1/452	08			
1/425A	06			
1/440A	01			
1/440B	03			
1/440E	04			
1/L410	02			
1/L412	05			
2/L412	05			
5/S1	11			
5/S2	11			
5/S3	11			
5/S4	17			
6/S1	11			
6/S2	11			
1/H424B	13			
1/H424C	14			
1/578	15			
1/522A	16			
1/550	18			

## SECTION 088000 - GLAZING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Glass products.
  - 2. Miscellaneous glazing materials.

#### 1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass.
- B. Product test reports.

#### 1.6 QUALITY ASSURANCE

### PART 2 - PRODUCTS

#### 2.1 GLASS PRODUCTS, GENERAL

- A. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having

jurisdiction . Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

- B. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
- C. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.2 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class I (clear), Quality Q3.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

## 2.3 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks:
  - 1. Silicone with Shore A durometer hardness of 85, plus or minus 5.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- C. Spacers:
  - 1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- D. Edge Blocks:
  - 1. Silicone with Shore A durometer hardness per manufacturer's written instructions.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## PART 3 - EXECUTION

### 3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

### 3.2 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.3 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

### 3.4 MONOLITHIC GLASS SCHEDULE

- A. Glass Type: Clear annealed and fully tempered float glass.
  - 1. Glass: float glass.
  - 2. Minimum Thickness: 6 mm.

END OF SECTION 088000



## SECTION 088700 - WINDOW FILM

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Architectural Window Film
- B. Blackout Film

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Flammability: Surface burning characteristics when tested in accordance ASTM E 84, demonstrating film applied to glass rated Class A for Interior Use.

#### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's current technical literature on each product to be used, including:
  - 1. Manufacturer's Data Sheets.
  - 2. Preparation instructions and recommendations.
  - 3. Storage and handling requirements and recommendations.
  - 4. Installation methods.
- B. Verification Samples: For each film specified, two samples representing actual film color and pattern.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
  - 1. Provide documentation that the adhesive used on the specified films is a Pressure Sensitive Adhesive (PSA).
- B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
  - 1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
  - 2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
    - a. Name of building.
    - b. The name and telephone number of a management contact.
    - c. Type of glass.
    - d. Type of film and/or film attachment system.
    - e. Amount of film and/or film attachment system installed.
    - f. Date of completion.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - 1. Finish 20 square foot areas designated by Architect.
  - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
  - 3. Refinish mock-up area as required to produce acceptable work.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Follow Manufacturer's instructions for storage and handling.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

## 1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

## 1.7 WARRANTY

- A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.
- B. Product shall be free from defects in material and manufacture for a period of 10 years from the date of installation.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturer: Basis-of-Design Manufacturer and Product is listed on the drawing finish schedule. Subject to compliance with requirements, available manufacturers include but are not limited to the following:
  - 1. 3M.
  - 2. Decorative Films, LLC.

### 2.2 WINDOW FILM (WF-1)

- A. Properties:
  - 1. Type: Vinyl.
  - 2. Color: As indicated on schedule.
  - 3. Adhesive Type: Pressure Sensitive.
  - 4. Thickness: Nominal 3.2 mils minimum.
- B. Optical Performance:
  - 1. Decorative / Privacy Glazing Film applied to 6 mm thick clear glass (ASTM E 903, ASTM E 308):
    - a. Shading Coefficient: 0.93.
    - b. Visible Light Reflectance: 8 percent.
    - c. Visible Light Transmittance: 85 percent.
    - d. Solar Heat Reflectance: 7 percent.
    - e. Solar Heat Transmittance: 76 percent.
    - f. Solar Heat Absorbance: 17 percent.
    - g. UV Transmittance: 27 percent.

### 2.3 BLACKOUT FILM (WF-2)

- A. Properties:
  - 1. Type: Polyester.
  - 2. Color: Black.
  - 3. Adhesive Type: Pressure Sensitive.
  - 4. Thickness: Nominal 2.0 mils minimum.
  
- B. Optical Performance:
  - 1. Decorative / Privacy Glazing Film applied to 3 mm thick clear glass (ASTM E 903, ASTM E 308):
    - a. Ultraviolet Transmission: 0 percent.
    - b. Visible Light Transmittance: 0 percent.
    - c. Visible Light Reflectance - Interior: 15 percent.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Film Examination:
  - 1. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
  - 2. Commencement of installation constitutes acceptance of conditions.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Refer to Manufacturer's installation instructions for methods of preparation for Impact Protection Adhesive or Impact Protection Profile film attachment systems.

### 3.3 INSTALLATION

- A. Film Installation, General:
  - 1. Install in accordance with manufacturer's instructions.
  - 2. Cut film edges neatly and square. Use new blade tips after 3 to 4 cuts.

### 3.4 CLEANING AND PROTECTION

- A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

## SECTION 08 88 13 - FIRE-RATED GLASS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Fire-rated glazing materials installed as vision lights in fire-rated doors.

#### 1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. ASTM E2010-01: Standard Test Method for Positive Pressure Fire Tests of Window Assemblies.
- B. American National Standards Institute (ANSI):
1. ANSI Z97.1: Standard for Safety Glazing Materials Used in Buildings
- C. Glass Association of North America (GANA):
1. GANA – Glazing Manual.
  2. FGMA – Sealant Manual.
- D. National Fire Protection Association (NFPA):
1. NFPA 80: Fire Doors and Windows.
  2. NFPA 252 – Fire Tests of Door Assemblies.
  3. NFPA 257 – Fire Tests of Window Assemblies.
- E. Underwriters Laboratories, Inc. (UL):
1. UL 9 – Fire Tests of Window Assemblies.
  2. UL 10B – Fire Tests of Door Assemblies.
  3. UL 10C – Positive Pressure Fire Tests of Door Assemblies.

#### 1.3 SUBMITTALS

- A. Product data: Submit manufacturer's technical data for each glazing material required, including installation and maintenance instructions.
- B. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements. Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction.
- C. Product Test Listings: From UL indicating fire-rated glass complies with requirements, based on comprehensive testing of current product.

#### 1.4 QUALITY ASSURANCE

- A. Glazing Standards: FGMA Glazing Manual and Sealant Manual.
- B. Fire Protective Rated Glass: Each lite shall bear permanent, non-removable label of UL certifying it for use in tested and rated fire protective assemblies.
- C. Fire Protective Glazing Products for Door Assemblies: Products identical to those tested per ASTM E 152, classified and labeled by UL or other certification agency acceptable to authorities having jurisdiction.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to specified destination in manufacturer's or distributor's packaging, undamaged, complete with installation instructions.
- B. Store off ground, under cover, protected from weather and construction activities.

#### 1.6 WARRANTY

- A. Provide manufacturer's standard three-year manufacturer's warranty.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS- (ACCEPTABLE MANUFACTURERS/PRODUCTS)

- A. Basis-of-Design Product: Subject to requirements provide the following or approved equivalent:
  - 1. Glazing Material:
    - a. "WireLite<sup>®</sup>NT" fire-rated glazing as distributed Technical Glass Products.
  - 2. Alternate Manufacturers: Manufacturers who provide equivalent products that may be incorporated into the work include but are not limited to:
    - a. Saft-First
    - b. VetroTech Saint-Gobain

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-rated wired glazing material with surface-applied film listed for use in impact safety-rated locations such as doors, transoms and borrowed lites with fire rating requirements ranging from 20 minutes to 90 minutes with hose stream test.

#### 2.3 MATERIALS-GLASS

- A. Fire Rated Glazing: Composed of wired glass with a surface-applied fire-rated film.
- B. Properties:
  - 1. Thickness: ¼" (6 mm)
  - 2. Film: Fire-rated surface film as approved by manufacturer.
  - 3. Weight: 3.79 lbs./sq. ft.(18.50 kg /m<sup>2</sup>)
  - 4. Approximate Visible Transmission: 77 percent.

5. Fire-rating: 20 minutes to 90 minutes for doors; 20 minutes to 45 minutes for other applications.
6. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
7. Positive Pressure Test: UL 10C; passes.

- C. Listings and Labels: Permanently label with the UL logo and fire rating in sizes up to 4,608 sq. in.
- D. Fire Rating: Fire rating classified and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E2010-01 NFPA 257 UL 9 and UL 10C.

## 2.4 GLAZING COMPOUND FOR FIRE-RATED GLAZING MATERIALS

- A. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent. Glass panels that exceed 1,296 sq. inches (.83 m<sup>2</sup>) for 20-90minute ratings must be glazed with Pemko FG3000 fire-rated glazing tape as supplied by installer.
- B. Glazing Compound: DAP 33 putty.
- C. Setting Blocks: Neoprene or EPDM, tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.
- D. Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

## 2.5 FABRICATION

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine glass framing, with glazier present, for compliance with the following:
  1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
  2. Minimum required face or edge clearances.
  3. Observable edge damage or face imperfections.
- B. Do not proceed with glazing until unsatisfactory conditions have been corrected.
- C. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

### 3.2 INSTALLATION (GLAZING)

- A. Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
- B. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
- C. Set units of glass in each series with uniformity of pattern, draw, bow, and similar characteristics.
- D. Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.
- E. Place setting blocks located at quarter points of glass with edge block no more than 6 inches from corners.
- F. Glaze vertically into labeled fire-rated metal frames or partition walls with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
- G. Place glazing tape on free perimeter of glazing in same manner described above.
- H. Install removable stop and secure without displacement of tape.
- I. [Use specified glazing compound, without adulteration; bed glazing material in glazing compound; entirely fill all recess and spaces. Provide visible glazing compound with smooth and straight edges.]
- J. Install in vision panels in fire-rated doors to requirements of NFPA 80.
- K. Install so that appropriate UL markings remain permanently visible.

### 3.3 PROTECTION AND CLEANING

- A. Protect glass from contact with contaminating substances resulting from construction operations. Remove any such substances by method approved by glass manufacturer.
- B. Wash glass on both faces not more than four days prior to date scheduled for inspections intended to establish date of substantial completion. Wash glass by method recommended by glass manufacturer.

### 3.4 GLAZING SCHEDULE

Rating	Assembly	Max. Exposed Area	Max. Width Of Exposed Glazing (In.)	<b>O</b> <b>R</b>	Max. Height Of Exposed Glazing
90 min.*	Doors (non-temp rise)	552 in2 (.36 m2) / 3.83 ft2	12" (305 mm)		46" (1,168 mm)

\*When glazed with PEMKO FG3000™ as supplied by installer.

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Rowan Project No. 77154

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PROJECT MANUAL

Kimmel Bogrette Architecture  
KBAS Project No. 21-008

END OF SECTION



## SECTION 092216 - NON-STRUCTURAL METAL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Framing systems.
  - 2. Suspension systems.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation reports for power-actuated fasteners.

#### 1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Stud Manufacturers Association .

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

#### 2.2 FRAMING SYSTEMS

- A. Studs and Track: AISI S220.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. MBA Building Supplies.
    - d. MRI Steel Framing, LLC.
    - e. SCAFCO Steel Stud Company; Stone Group of Companies.

2. Minimum Base-Steel Thickness: 0.0329 inch.
  3. Depth: As indicated on Drawings .
- B. Slip-Type Head Joints: Where indicated, provide the following:
1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) ClarkDietrich.
      - 2) MarinoWARE.
      - 3) MBA Building Supplies.
      - 4) MRI Steel Framing, LLC.
      - 5) SCAFCO Steel Stud Company; Stone Group of Companies.
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. MBA Building Supplies.
    - d. MRI Steel Framing, LLC.
    - e. SCAFCO Steel Stud Company; Stone Group of Companies.
  2. Minimum Base-Steel Thickness: 0.0329 inch .
- D. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch- wide flanges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. MBA Building Supplies.
    - d. MRI Steel Framing, LLC.
    - e. SCAFCO Steel Stud Company; Stone Group of Companies.
  2. Depth: 1-1/2 inches .
  3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- E. Hat-Shaped, Rigid Furring Channels:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. MBA Building Supplies.
    - d. MRI Steel Framing, LLC.
    - e. SCAFCO Steel Stud Company; Stone Group of Companies.
  2. Minimum Base-Steel Thickness: 0.0179 inch .
  3. Depth: As indicated on Drawings .

- F. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 3/4 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. MBA Building Supplies.
    - d. MRI Steel Framing, LLC.
    - e. SCAFCO Steel Stud Company; Stone Group of Companies.

## 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- C. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.
1. Depth: 1-1/2 inches.
- D. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
  2. Steel Studs and Tracks: Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.
    - a. Minimum Base-Steel Thickness: 0.0296 inch.
    - b. Depth: 1-5/8 inches.
  3. Hat-Shaped, Rigid Furring Channels: 7/8 inch deep.
    - a. Minimum Base-Steel Thickness: 0.0179 inch.

## 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
  - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.2 INSTALLATION OF FRAMING SYSTEMS

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
  - 6. Curved Partitions:
    - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.

- b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.
- E. Direct Furring:
  - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Z-Shaped Furring Members:
  - 1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
  - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
  - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.3 INSTALLATION OF SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards .
  - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 5. Do not attach hangers to steel roof deck.
  - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.

7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

#### 3.4 FIELD QUALITY CONTROL

- A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

#### 1.2 ACTION SUBMITTALS

- A. Product data.
- B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.
- C. Samples: For each texture finish indicated on same backing indicated for Work.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

#### 2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

#### 2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C1396/C1396M.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed; SAINT-GOBAIN.
    - c. Gold Bond Building Products, LLC provided by National Gypsum Company.
    - d. USG Corporation.

2. Thickness: 5/8 inch.
  3. Long Edges: Tapered .
- B. Gypsum Board, Type X: ASTM C1396/C1396M.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed; SAINT-GOBAIN.
    - c. Gold Bond Building Products, LLC provided by National Gypsum Company.
    - d. USG Corporation.
  2. Thickness: 5/8 inch.
  3. Long Edges: Tapered .
- C. Gypsum Ceiling Board: ASTM C1396/C1396M.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed; SAINT-GOBAIN.
    - c. Gold Bond Building Products, LLC provided by National Gypsum Company.
  2. Thickness: 1/2 inch.
  3. Long Edges: Tapered.
- D. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested in accordance with ASTM C1629/C1629M.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed; SAINT-GOBAIN.
    - c. Gold Bond Building Products, LLC provided by National Gypsum Company.
    - d. USG Corporation.
  2. Core: 5/8 inch , Type X.
  3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 1 Level 2 requirements.
  4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 Level 2 requirements.
  5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 1 Level 2 requirements.
  6. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 1 Level 2 requirements in accordance with test in Annex A1.
  7. Long Edges: Tapered.
  8. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
- E. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed; SAINT-GOBAIN.
    - c. Gold Bond Building Products, LLC provided by National Gypsum Company.
    - d. USG Corporation.
  2. Core: 5/8 inch , Type X.
  3. Long Edges: Tapered.



4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

## 2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C-Cure.
    - b. Custom Building Products.
    - c. FinPan, Inc.
    - d. PermaBASE Building Products, LLC provided by National Gypsum Company.
    - e. USG Corporation.
  2. Thickness: 5/8 inch .
  3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

## 2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
  1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc .
  2. Shapes:
    - a. Cornerbead.
    - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - c. L-Bead: L-shaped; exposed long flange receives joint compound.
    - d. Expansion (control) joint.
    - e. Curved-Edge Cornerbead: With notched or flexible flanges.

## 2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
  1. Interior Gypsum Board: Paper.
  2. Exterior Gypsum Soffit Board: Paper.
  3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
  4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
  1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use setting-type, sandable topping compound.
  4. Finish Coat: For third coat, use setting-type, sandable topping compound.
  5. .
- D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.

## 2.7 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
  1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C840.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. Install control joints in drywall surfaces where continuous runs equal or exceed 30 feet and as indicated on drawings.
- E. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

### 3.2 FINISHING OF GYPSUM BOARD

- A. Prefill open joints and damaged surface areas.
- B. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

- C. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for tile **<Insert locations>**.
  - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated .
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
  
- D. Cementitious Backer Units: Finish according to manufacturer's written instructions.

### 3.3 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
  
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

## SECTION 093013 - CERAMIC TILING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Porcelain tile.
2. Glazed wall tile.
3. Waterproof membranes.
4. Crack isolation membranes.
5. Setting material.
6. Grout materials.
7. Metal edge strips.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data:

1. Porcelain tile.
2. Glazed wall tile.
3. Waterproof membranes.
4. Crack isolation membranes.
5. Setting material.
6. Grout materials.
7. Metal edge strips.

##### B. Shop Drawings: Show locations, plans, and elevations, of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces. Show thresholds.

##### C. Samples:

1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 36 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Stone thresholds in 6-inch lengths.

#### 1.3 INFORMATIONAL SUBMITTALS

##### A. Qualification Data: For Installer.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
  - 2. Installer employs only Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.

### PART 2 - PRODUCTS

#### 2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

#### 2.2 TILE

- A. Tile Type: Basis-of-Design tiles are indicated on drawing schedule.
  - 1. Certification: Tile certified by the Porcelain Tile Certification Agency.
  - 2. Face Size: As indicated.
  - 3. Face Size Variation: Rectified.
  - 4. Thickness: As indicated.
  - 5. Physical Properties: Chemical resistant when tested with indicated chemicals in accordance with ASTM C650.
  - 6. Tile Color, Glaze, and Pattern: As indicated.
  - 7. Grout Color: As selected by Architect from manufacturer's full range.
  - 8. Precoat with temporary protective coating.
  - 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
    - a. Base Cap: Surface bullnose, module size same as adjoining flat tile .
    - b. Wainscot Cap: Surface bullnose, module size same as adjoining flat tile .
    - c. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it; same size as adjoining flat tile.
    - d. External Corners: Surface bullnose, module size same as adjoining flat tile or edge strip as specified.

- e. Internal Corners: Field-buttet square corners.
- f. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

## 2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
  - 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of 10 in accordance with ASTM C1353/C1353M or ASTM C241/C241M and with honed finish.
  - 1. Description:
    - a. Uniform, fine- to medium-grained white stone with gray veining.
    - b. Match Architect's sample.
    - c. Provide [ one of] the following:
      - 1) <Insert, in separate subparagraphs, name of variety and producer, distributor, or importer>.

## 2.4 WATERPROOF MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Waterproof Membrane, Sheet: Polyethylene sheet faced on one or both sides with polyester fabric.
- C. Waterproof Membrane, Fluid Applied: Liquid-latex rubber or elastomeric polymer.
  - 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. ARDEX Americas.
    - b. Bostik; Arkema.
    - c. Laticrete International, Inc.
    - d. MAPEI Corporation.
    - e. Sika Corporation.

## 2.5 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
  - 1. Cleavage Membrane: Installer's option of material that complies with ANSI A108.02, paragraph 3.8.
  - 2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A1064/A1064M except for minimum wire size.

3. Latex Additive: Manufacturer's standard acrylic resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

B. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ARDEX Americas.
  - b. Bostik; Arkema.
  - c. Laticrete International, Inc.
  - d. MAPEI Corporation.
  - e. Parex USA, Inc.
  - f. Summitville Tiles, Inc.
2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.1.

C. Organic adhesive: ANSI A136.1, Type I.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ARDEX Americas.
  - b. Bostik; Arkema.
  - c. Laticrete International, Inc.
  - d. MAPEI Corporation.
  - e. Parex USA, Inc.

## 2.6 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. High Performance Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ardex Americas.
  - b. Bostik; Arkema.
  - c. Laticrete International, Inc.
  - d. MAPEI Corporation.
  - e. Summitville Tiles, Inc.

## 2.7 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.

- B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils thick.

- C. Metal Flooring Transitions: Profile designed specifically for flooring applications; height to match tile and setting-bed thickness.
  - 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. Custom Building Products.
    - b. Profilitec Corp.
    - c. Progress Profiles America Inc.
    - d. Schluter Systems L.P.
  - 2. Description: Profiles as indicated on drawings.
  - 3. Material and Finish: Metallic; brushed chrome anodized aluminum exposed-edge material.
- D. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
- E. Temporary Protective Coating: Formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products and easily removable after grouting is completed without damaging grout or tile.
- F. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- G. Grout Sealer: Grout manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  - 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.



- B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot toward drains.
- D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- E. Substrate Flatness:
  - 1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
  - 2. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.
- F. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

### 3.3 INSTALLATION OF CERAMIC TILE SYSTEM

- A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.
- B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
  - 1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.
- C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
  - 1. Allow crack isolation membrane to cure before installing tile or setting materials over it.
- D. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.
- E. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- F. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight

aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

- G. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- H. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- I. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- J. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- K. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.
  - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- L. Thresholds: Install stone and solid surface thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
  - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in modified dry-set mortar (thinset).
  - 2. Do not extend waterproof membrane or crack isolation membrane under thresholds set in standard dry-set mortar. Fill joints between such thresholds and adjoining tile set on waterproof membrane or crack isolation membrane with elastomeric sealant.
- M. Metal Flooring Transitions: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- N. Metal Edge Strips: Install at locations indicated, where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile, where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- O. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### 3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Wall Installations, Wood or Metal Studs or Furring:
  - 1. TCNA W242: Organic adhesive on gypsum board.
    - a. Grout: Polymer modified tile grout: ANSI A118.7.
    - b. Organic Adhesive: ANSI A136.1.
    - c. Joint Width: 1/8 inch.
    - d. Movement Joints: Types located on Drawings.
- B. Interior Floor Installations, Concrete:

1. TCNA F122: Thinset mortar over waterproof membrane.
  - a. Latex Portland cement mortar” ANSI A118.4.
  - b. Polymer modified tile grout: ANSI 118.7.
  - c. Liquid applied waterproofing.
  - d. Joint Width: 1/8 inch.
  - e. Movement Joints: Types located on Drawings.

END OF SECTION 093013

## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Acoustical panels.
  - 2. Metal suspension system.
  - 3. Metal edge moldings and trim.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Product test reports.
- C. Research reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Class A in accordance with ASTM E1264.
  - 2. Smoke-Developed Index: 50 or less.

#### 2.2 ACOUSTICAL PANELS

- A. Basis-of-Design manufacturer: Armstrong Ceilings as indicated on drawings.

1. Subject to compliance with requirements, provide listed products or equivalent by one of the following:
  - a. Certain Teed SAINT-GOBAIN.
  - b. USG Corporation.
- B. Acoustical Panel Standard: Manufacturer's standard panels in accordance with ASTM E1264.
- C. Color: As indicated on Drawings .
- D. Edge/Joint Detail: As indicated by manufacturer's designation .
- E. Modular Size: As indicated on Drawings .

## 2.3 METAL SUSPENSION SYSTEM

- A. Basis-of-Design manufacturer: Armstrong Ceilings as indicated on drawings.
  1. Subject to compliance with requirements, provide listed products or equivalent by one of the following:
    - a. Certain Teed SAINT-GOBAIN.
    - b. USG Corporation.
  - B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M. Size as listed on drawings.
  - C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch- wide metal caps on flanges.
    1. Structural Classification: **Heavy**-duty system.
    2. End Condition of Cross Runners: **butt-edge** type.
    3. Face Design: **Flat, flush**.
    4. Cap Material: **Cold-rolled steel or aluminum**.
    5. Cap Finish: **Painted white**.
  - D. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 9/16-inch- wide metal caps on flanges.
    1. Structural Classification: **Heavy**-duty system.
    2. End Condition of Cross Runners: **butt-edge** type.
    3. Face Design: **Flat, flush**.
    4. Cap Material: **Cold-rolled steel or aluminum**.
    5. Cap Finish: **Painted white**.

## 2.4 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

## 2.5 METAL EDGE MOLDINGS AND TRIM

- A. Basis-of-Design manufacturer: Armstrong Ceilings as indicated on drawings.
  - 1. Subject to compliance with requirements, provide listed products or equivalent by one of the following:
    - a. Certain Teed SAINT-GOBAIN.
    - b. USG Corporation.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated.
- B. Layout openings for penetrations centered on the penetrating items.

### 3.2 INSTALLATION

- A. Install acoustical panel ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.
- B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
  - 3. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.

END OF SECTION 095113

## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Thermoset-rubber base.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

#### 2.2 THERMOSET-RUBBER BASE

- A. Basis-of-Design Manufacturer: Roppe as indicated on drawings.
  - 1. Subject to compliance with requirements, provide listed products or equivalent by one of the following:
    - a. Flexco Corporation.
    - b. Johnsonite: A Tarkett Company.
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
  - 1. Style and Location:
    - a. Style B, Cove: Provide in areas with resilient floor coverings .
- C. Thickness: 0.125 inch.
- D. Height: 4 inches .
- E. Lengths: Coils in manufacturer's standard length .
- F. Outside Corners: Job formed or preformed.
- G. Inside Corners: Job formed or preformed.

- H. Colors: As indicated on drawings.

## 2.3 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
  - 1. Adhesives shall have a VOC content of 50 g/L or less.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Form without producing discoloration (whitening) at bends.



2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
  - a. Miter or cope corners to minimize open joints.

### 3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

## SECTION 096536 – STATIC CONTROL RESILIENT FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Static Control Vinyl Flooring

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and pattern specified.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

#### 1.5 WARRANTY

- A. Warranty: Provide manufacturer's standard warranty, including the following:
  - 1. Static control vinyl flooring: Tile:
    - a. Manufacturer's standard warranty for installed flooring, for period of 10 years from date of purchase for materials.
    - b. Manufacturer's standard warranty for the lifetime of the installed floor for electrical properties from the date of testing and certification by authorized representative of flooring manufacturer.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

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

## 2.2 STATIC CONTROL RESILIENT FLOORING (SDT-1)

- A. Basis-of-Design Manufacturer: Armstrong Flooring as indicated on drawings.
  - 1. Subject to compliance with requirements, provide listed products or equivalent by one of the following:
    - a. Roppe.
    - b. Staticworx, Inc..
- B. Electrical Resistance, Surface to Ground: 1,000,000 to < 1,000,000,000 (1 x 10<sup>6</sup> to < 1 x 10<sup>9</sup> Ohms) when tested in accordance with ANSI/ESD STM7.1-2020 & ASTM F 150.
- C. Static Decay: Less than 0.2 seconds, from 5,000 volts to 0 volts, when tested in accordance with FTM 101C, Method 4046.1.
- D. Static Generation: Less than 100 volts with conductive footwear at 12 percent relative humidity.
- E. Thickness: **0.125 inch.**
- F. Size: **12 by 12 inches.**
- G. Colors and Patterns: As indicated on drawings.

## 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Concrete Substrate Moisture Test Kit: Calcium chloride type kit, as required to conduct ASTM F 1869 tests; as recommended by flooring manufacturer.
- C. Adhesives: Conductive water-based acrylic adhesive recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- D. Grounding Strips: Copper foil, of type recommended by flooring manufacturer; provide minimum of 1 strip 2" x 24" per 1,000 square feet (93 sq. m) and minimum of 3 in a single room.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
  4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### 3.2 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
1. Lay tiles in pattern indicated .
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
1. Lay tiles in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Test electrical properties of flooring in accordance with manufacturer's recommendations. Correct any defects prior to Substantial Completion.

### 3.3 PROTECTION

- A. Protect installed products, including but not limited to finished flooring system, from damage until Substantial Completion.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

### 3.4 CLEANING

- A. Refer to manufacturers instructions for proper cleaning and maintenance of the products.

END OF SECTION 096519

## SECTION 096813 - TILE CARPETING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Modular carpet tile.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples: For each exposed product and for each color and texture required.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

#### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

## 1.6 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 CARPET TILE

- A. Basis-of-Design Manufacturer: Patcraft as indicated on drawings.
1. Subject to compliance with requirements, provide listed products or equivalent by one of the following:
    - a. Interface, Inc.
    - b. Mannington Commercial.
    - c. Mohawk Carpet, LLC
    - d. Shaw Industries Group, Inc.
    - e. Tarkett USA.
- B. Color: As indicated on drawings.
- C. Pattern: As indicated on drawings .
- D. Fiber Content: 100 percent nylon 6, 6 .
- E. Pile Characteristic: Mult-level pattern loop.
- F. Dye Method: 100% solution dyed.
- G. Backing System: Ecoworx.
- H. Size: 18 by 36 inches .
- I. Applied Treatments:
1. Soil-Resistance Treatment: Manufacturer's standard treatment .
- J. Performance Characteristics:
1. Appearance Retention Rating: Severe traffic, 3.5 minimum according to ASTM D7330.
  2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
  3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D2646.
  4. Tuft Bind: Not less than 6.2 lbf according to ASTM D1335.
  5. Delamination: Not less than 3.5 lbf/in. according to ASTM D3936.

6. Dimensional Tolerance: Within **1/32 inch** of specified size dimensions, as determined by physical measurement.
7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
8. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
9. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.

## 2.2 INSTALLATION ACCESSORIES

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Concrete Slabs:
  1. Moisture Testing: Perform tests so that each test area does not exceed **1000 sq. ft.**, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft.** in 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
    - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

### 3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. 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** unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.



### 3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive .
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns indicated on Drawings .
- E. 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.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.
- I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.
- J. 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.

END OF SECTION 096813

## SECTION 09 69 33 – CABLE MANAGEMENT ACCESS FLOOR SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. A low profile cable management access flooring structure with access panels, base connectors to connect access panels, to form reticulated accessible cable trenches, and which covered and protected by cable trench caps.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. General: The low profile access flooring, when installed, structured with self-standing access panels, grid-pattern cable trenches, facilitating easy distribution, extension of electrical, networking and telecommunication cables, and accommodate outlet floor boxes, and cable trench caps to cover and protect cables running in the cable trenches.
- B. Access panels and steel cable trench caps  
Tested in accordance with CISCA
  1. Concentrated Load: by 1" square indenter
    - a. 400 psi: less than 0.1" (2.5 mm) depression
  2. Concentrate Ultimate Load: by 1" square indenter
    - a. greater than 500 psi
  3. Uniform Distribution Load:
    - a. 1300 psf: less than 0.06" (1.5 mm) depression
  4. Uniform Ultimate Load:
    - a. Greater than 4500 psf
- C. Flammability: meet NFPA 253 class A as tests in accordance with ASTM E-648 Critical Radiant Flux, UL94-V2.
- D. Earthquake Performance: access panel are self-stand, each panel supported by 64 built-in pedestals. Each panel is connected by Base Connector at four corner pedestals. In the event of earthquake, the system will not be collapsed.
- E. Environment protection:
  1. Access panels made of recycled poly-propylene contents more than 60%.
  2. The access panels are self-stand. No adhesives required to bond access panels' pedestals onto sub-floors. No pollution to sub-floors at time of installation.
  3. No damage to sub-floors: At time of relocation, no damage to sub-floors.

4. Re-usable: In the event of re-location, the systems' components shall be more than 95% re-usable.
5. 100% recyclable: All components of the systems, access panels, base connectors, cable trench caps, sound attenuation blanket, and accessories, are 100% recyclable.

### 1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include layout, details, sections, and relationship to adjoining Work, including ramp details and detail components of assembly and edge details.
- C. Samples: For each type of product and exposed finish.
- D. Product test reports.

### 1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals to demonstrate aesthetic effects and to set quality standards for materials and execution.
  1. Build mockup of typical access-flooring assembly. Size to be an area no fewer than five floor panels in length by floor panels in width.
  2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### 1.5 WARRANTY

- A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.
- B. Product shall be free from defects in material and manufacture for a period of 5 years from the date of installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturer: Basis-of-Design Manufacturer shall be Netfloor Inc., product as indicated below. Subject to compliance with requirements, other available manufacturers include but are not limited to the following:
  1. FreeAxez Manufacturing, LLC.

### 2.2 ACCESS FLOOR SYSTEM AND COMPONENTS

- A. The system
  1. Netfloor USA low profile access floor systems
  2. System: CA400R series
  3. System height: 1.57".

4. Modular size: 23.62" X 23.62" consists of 1 access panel (UniPanel), 1 Base Connector, 1 Central Cap, and 4 Flank Caps.
  5. System weight: 2.56 LB per square foot.
  6. Manufacturer: Netfloor, Inc.
- B. Access Panels (UniPanels): self-standing access panel, each panel consists 16 sub-panels, 64 built-in pedestals.
1. Panel size: 20.08" X 20.08".
  2. Height: fixed height 1.57".
  3. Material: fire-retard recycled poly-propylene, Class A..
  4. Concentration Load: 400psi minimum.
- C. Cable Trench Caps: to cover the cable trenches.
- D. Central Caps: size 5.91" X 5.91", made of 0.09" thick steel, 5 mm bend at four sides, reinforced ribs at center, to install, and cover, at intersection of cable trenches, protection against corrosion by electro-deposition.
- E. Flank Caps: size 8.78" X 4.72", reinforced ribs, to install, and cover cable trenches, at sides of access panels. Made of 0.09" thick steel, protection against corrosion by electro-deposition.
- F. Base Connectors: size 6.65" X 6.65" X 0.59", made of recycled poly-carbonate plus ABS.
- G. Sound Attenuation Blanket: meet UL94 HB, PE foam, 1 meter width, 0.08" thick, install under access panels to absorb impact sound causing by pedestrians.
- H. Cable Trenches configuration: At time of installation, apply Base Connectors to access panels' corner pedestals. Continuous connection at access panels' pedestals, automatically forms standard distance 3.54" wide, reticulated cable trenches within every 23.62" distance.
- I. Cable Trenches capacity:
1. Width: 3.54".
  2. Clearance: 1.37".

## 2.3 ACCESS FLOOR COVERINGS

- A. The systems are suitable for bonded by commercial grade modular carpet tiles, and vinyl tiles of no less than 0.18" thick.

## 2.4 ACCESSORIES

- A. Accessories: All accessories for perimeter, re-enforcement, and others, as indicated on the manufacturer's system drawings, including but not limited to

the following:

1. W-Type ramp systems, 24 inches wide, including straight and corner sections.
2. Edge rail and trim for perimeter installation.
3. Starting caps to conceal gaps at cable trenches.
4. Exit caps and grommets.
5. Power and data floor boxes.
6. Uni-panel supporters.
7. Four circuit and one circuit power entry devices as determined based on floor box layout.
8. Power distribution boxes as determined based on floor box layout.
9. Electrical point boxes as determined based on floor box layout.
10. Wall mount receptacles, free end to desktop, facilities or wall receptacles.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Job site: shall be free of vibration, rocking, cracking, grease, or debris. All debris, foreign objects shall be removed before installation.

#### 3.2 INSTALLATION

1. Install access flooring system by qualified raised floor installation teams, and by following manufacturer's installation guide.
2. Access floor system shall comply with requirements by specific application per manufacturer's system and shop drawings.

#### 3.3 CLEANING AND PROTECTION

- A. Clean access flooring after installation. All residuals shall be removed from the job site.
- B. Other trades, such as electrical sub-contractors, when removing cable trenches' caps for cable routing, shall place the caps at proper and safe location, and shall re-store removed cable trenches back onto cable trenches at original position right after completion of electrical work.
- C. Other trades, when working on top of access floors, shall provide proper and adequate protection. Heavy carts or equipment, when passing through access floors, shall apply continuous plywood panels of minimum ½ inch thick to protect from work of other trades.
- D. Moving extra-heavy carts or lifts on access floor: Consult the manufacturer's regional distributor, or regional sales representative.

END OF SECTION 096933

## SECTION 09 9133 - PAINTING AND COATING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes surface preparation and field painting of the following:
1. Exposed exterior items and surfaces.
  2. Exposed interior items and surfaces.
  3. Repainting and surface preparation at areas of remodeling. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
1. Prefinished items include the following factory-finished components:
    - a. Architectural woodwork and casework, unless otherwise indicated.
    - b. Acoustical wall panels.
    - c. Toilet compartments.
    - d. Elevator entrance doors and frames.
    - e. Elevator equipment.
    - f. Finished mechanical and electrical equipment, unless otherwise indicated.
    - g. Light fixtures.
    - h. Distribution cabinets, except when in corridors or other normally occupied rooms.
  2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
    - a. Foundation spaces.
    - b. Furred areas.
    - c. Ceiling plenums.
    - d. Utility tunnels.
    - e. Pipe spaces.
    - f. Duct shafts.
    - g. Elevator shafts.
  3. Finished metal surfaces include the following:
    - a. Anodized aluminum.
    - b. Stainless steel, except exposed metal flashing indicated for field-painted finish.
    - c. Chromium plate.
    - d. Copper.
    - e. Bronze and brass.
  4. Operating parts include moving parts of operating equipment and the following:
    - a. Valve and damper operators.
    - b. Linkages.
    - c. Sensing devices.

- d. Motor and fan shafts.
  - e. Sprinkler heads.
5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

## 1.2 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
- 1. Flat: Lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
  - 2. Eggshell: Low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
  - 3. Satin: Low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
  - 4. Semigloss: Medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
  - 5. Full Gloss: High-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

## 1.3 SUBMITTALS

- A. Product Data: For each paint system specified. Include block fillers and primers.
- 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
  - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
- 1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
  - 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
- C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

## 1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type and color of coating and substrate required on the Project. Comply with procedures specified in PDCA P5. Duplicate finish of approved prepared samples.

1. Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
  - a. Wall Surfaces: Provide samples on at least 100 sq. ft. of wall surface.
  - b. Small Areas and Items: The Architect will designate an item or area as required.
2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.
  - a. After finishes are accepted, the Architect will use the room or surface to evaluate coating systems of a similar nature.
3. Final approval of colors will be from job-applied samples.

#### 1.5 REGULATORY REQUIREMENTS

- A. Comply with the applicable provisions of all codes, standards and specifications referenced in this section.
  1. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the limits for VOC content of the Ozone Transport Commission (OTC) effective January 1st, 2005.

#### 1.6 PRODUCT HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
  1. Product name or title of material.
  2. Product description (generic classification or binder type).
  3. Manufacturer's stock number and date of manufacture.
  4. Contents by volume, for pigment and vehicle constituents.
  5. Thinning instructions.
  6. Application instructions.
  7. Color name and number.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
  1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

#### 1.7 PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F.
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F.
- C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
  1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.



## 1.8 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to area designated by Owner.
1. Quantity: Furnish the Owner with an additional 5 percent, but not less than 2 gal. of each material and color applied.
    - a. Provide not less than 2 gal. for each part of multi-part formulations such as epoxy coatings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the product listed in the Room Finish Schedule, one of the products in the paint schedules or a comparable product by one of the manufacturers listed below.
- B. Manufacturers Names: One or more of the following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
1. Benjamin Moore (BM).
  2. Sherwin Williams (SW).
  3. PPG Paints (PPG).
  4. Samuel Cabot (Cabot).
  5. Minwax Company (Minwax).

### 2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Provide systems indicated. Where substrates are required to be finished, but no system is specified for that particular substrate, employ finish system most closely related to that scope of work but modified with appropriate primers. In the case of components on walls, use system for adjacent wall or trim as determined by Architect. In the case of components on or suspended from ceilings or decks, use semigloss paint system.
- C. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction. and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base:
1. Flat Paints and Coatings: 50 g/L.
  2. Nonflat Paints and Coatings: 150 g/L.
  3. Dry-Fog Coatings: 400 g/L.

4. Primers, Sealers, and Undercoaters: 200 g/L.
  5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
  6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
  7. Pretreatment Wash Primers: 420 g/L.
  8. Floor Coatings: 100 g/L.
  9. Shellacs, Clear: 730 g/L.
  10. Shellacs, Pigmented: 550 g/L.
- E. Colors: Match colors indicated by reference to manufacturer's color designations.
1. Provide contrasting colors for different elements exposed at ceiling level as selected by Architect, including steel trusses, roof deck, and ductwork.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
  2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

### 3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
  2. Mask surfaces and construction adjacent to paint application areas to prevent paint from spilling or spattering other areas.
- B. Preparing Previously Painted Surfaces: Remove existing paint from surfaces indicated using scrapers or chemical paint stripper as follows:
1. Strip loose, chipped, alligatored or otherwise deteriorated paint using methods that will not damage existing surfaces.
  2. Remove paint to sound substrate. Sound, well-adhered paint may remain on surface.
  3. Rub steel surfaces to remove rust bloom, and solvent clean prior to priming.
  4. Allow surfaces to dry and sand smooth.
  5. Clean surfaces so they are free of dust and dirt.
  6. Fill cracks, gouges and nail holes with suitable filler prior to application of first coat.
  7. Complete surface preparation to produce a smooth, uniform substrate suitable for application of primer and finish coats specified.
  8. Apply test patch to confirm adhesion and compatibility. Check adhesion after 7 days.

- C. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and reprime.
  2. Cementitious Materials: Prepare concrete and masonry surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
    - a. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
  3. Precast Concrete Surfaces: Finish patched or repaired areas to provide a uniform texture and surface. Grind down any ridges or other protrusions flush with surrounding surfaces; remove all grinding sludge and dust.
    - a. After surfaces are prepared and dry, apply a full coat of surface primer specified in Part 2 for precast concrete surfaces, over entire surface. Allow to dry before application of textured paint finish.
  4. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
    - a. When transparent finish is required, backprime with spar varnish.
  5. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
    - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
    - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
    - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
  6. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
  7. Previously Painted Surfaces: If in sound condition, clean the surface of all foreign material. Smooth, hard or glossy coatings and surfaces should be dulled by abrading the surface. Apply a test area, allowing paint to dry one week before testing adhesion. If adhesion is poor, additional abrasion of the surface and/or removal of the previous coating may be necessary. Retest surface for adhesion. If paint is peeling or badly weathered, clean surface to sound substrate and treat as a new surface as above. Recognize that any surface preparation short of total removal of the old coating may compromise the service length of the system.
- E. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
  3. Use only thinners approved by paint manufacturer and only within recommended limits.
- F. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

### 3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the schedules.
  2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
  3. Provide finish coats that are compatible with primers used.
  4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
  5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
  7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
  8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
  9. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
  2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
  3. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
  2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
    - a. For electrostatic painting, use spray equipment designed to negatively charge the paint particles, with a connection of spray gun to a generator.
  4. Use rollers, not spray equipment, for application on sound-absorbing concrete masonry units.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer. Use application rate to achieve finished dry film thickness (DFT) as indicated for each coat.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
1. Cabinet heater enclosures.
  2. Piping, pipe hangers, and supports.
  3. Heat exchangers.
  4. Tanks.
  5. Ductwork.
  6. Insulation.
  7. Supports.
  8. Motors and mechanical equipment.
  9. Accessory items.
- G. Electrical items to be painted include, but are not limited to, the following:
1. Conduit and fittings.
  2. Switchgear.
  3. Panelboards.
- H. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been field prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- J. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
1. Provide satin finish for final coats.
- K. Electrostatic Painting: Connect target substrate to be painted to ground to create magnetic surface that will attract negatively charged paint particles. Apply paint to prepare surfaces to produce uniform, regular coating layers and a smooth, even finish.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

### 3.4 CLEANING AND PROTECTION

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
  - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.
- B. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- C. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
  - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

### 3.5 EXTERIOR PAINT SCHEDULE

- A. General: Provide the finish systems scheduled for each material type indicated, applied at spreading rate recommended by manufacturer to achieve the total dry film thickness (DFT) listed.
  - 1. Provide 2 finish coats over the listed base coats (primer, filler, bond coat) except as otherwise indicated.
- B. Exterior Zinc-Coated Metal:
  - 1. Full-Gloss, Siliconized Alkyd-Enamel or Polyurethane Finish:
    - a. Primer: Galvanized metal primer.
      - 1) SW: Pro-Cryl Universal Primer.
      - 2) PPG: Pitt-Tech® Plus Int/Ext DTM Industrial Primer 90-912 series
      - 3) BM: Super Spec Acrylic Metal Primer (P04)
    - b. First and Second Coats: Full-gloss, exterior, siliconized alkyd enamel containing not less than 30 percent silicone or polyurethane finish.
      - 1) SW: Sher-Cryl HP Acrylic, semi-gloss.
      - 2) PPG: Pitt-Tech® Plus Int/Ext Semi-Gloss DTM Industrial Enamel 90-1210 series.
      - 3) BM: Ultras Spec HP DTM Acrylic Gloss Enamel (HP28)

### 3.6 INTERIOR PAINT SCHEDULE

- A. General: Provide the finish systems scheduled for each material type indicated, applied at spreading rate recommended by manufacturer to achieve the total dry film thickness (DFT) listed.
  - 1. Provide 2 finish coats over the listed base coats (primer, filler, bond coat) except as otherwise indicated.
- B. Gypsum Board Ceilings and Soffits:
  - 1. Flat Acrylic Finish: Provide the following unless otherwise indicated.
    - a. Primer: Latex-based, interior primer.
      - 1) SW: Promar 200 Primer.
      - 2) PPG: SPEEDHIDE® Zero VOC Int Latex Sealer 6-4900
      - 3) BM: Ultra Spec 500 Int. Latex Primer (N534)
    - b. First and Second Coats: Flat, acrylic-latex-based, interior paint.
      - 1) SW: ProMar 200 Zero VOC Latex Flat
      - 2) PPG: SPEEDHIDE® Zero VOC Latex Flat 6-4110 series

- 3) BM: Ultra Spec 500 Int. Latex Flat (N536)

C. Gypsum Board Walls:

1. Eggshell, Acrylic-Enamel Finish: Provide the following unless otherwise indicated.
  - a. Primer: Latex-based, interior primer.
    - 1) SW: Promar 200 Primer
    - 2) PPG: SPEEDHIDE® Zero VOC Int Latex Sealer 6-4900
    - 3) BM: Ultra Spec 500 Int. Latex Primer (N534)
  - b. First and Second Coats: Eggshell, scrubbable acrylic-latex, interior enamel.
    - 1) SW: ProMar 200 Latex Eggshell
    - 2) PPG: SPEEDHIDE® Zero VOC Int Latex Eggshell 6-4310 series
    - 3) BM: Ultra Spec 500 Int. Latex Eggshell (N538)

D. Gypsum Board, Moisture Conditions:

1. Water-Reducible Epoxy Coating System: Provide the following for **gypsum board surfaces located in toilet rooms**.
  - a. Primer: Latex-based, interior primer.
    - 1) SW: ProMar 200 Primer
    - 2) PPG: SEAL GRIP Acrylic Universal Primer/Sealer 17-921 series
    - 3) BM: Ultra Spec 500 Int. Latex Primer (N534)
  - b. First and Second Coats: Semi-gloss epoxy finish.
    - 1) SW: ProIndustrial Pre-Catalyzed Epoxy, semi-gloss.
    - 2) PPG: PITT-GLAZE WB SG Pre-Catalyzed Acrylic Epoxy 16-510

E. Stained Interior Woodwork:

1. Polyurethane, Satin-Varnish Finish:
  - a. Stain Coat:
    - 1) Minwax 250 interior wood stain.
    - 2) PPG: Olympic Interior Stains 41533 series
  - b. Sealer Coat: Polyurethane reduced as recommended by manufacturer for use as sanding sealer.
  - c. First and Second Finish Coats: Polyurethane varnish.
    - 1) SW: Wood Classics WB Polyurethane, satin.
    - 2) PPG: Olympic WB Polyurethane Clear Satin 42786

F. Components at Ceiling Level: Apply the following coating system to exposed structure and other elements in exposed high areas.

1. Dry Fall, Flat Finish:
  - a. Primer:
    - 1) SW: Pro-Industrial Pro-Cryl Primer
  - b. First and Second Coats: S/W ProIndustrial Waterborne Dryfall flat.

G. Interior Ferrous Metal: Apply the following coating system to interior ferrous metal not scheduled to receive another coating.

1. Semigloss, DTM Acrylic-Enamel Finish:
  - a. Primer: Metal primer.
    - 1) SW: DTM Primer
    - 2) PPG: Pitt-Tech Primer / Finish DTM Industrial Enamel 90-712
    - 3) BM: Super Spec HP Acrylic Metal Primer (P04)
  - b. First and Second Coats: Semigloss, alkyd, interior enamel.
    - 1) SW: DTM Acrylic Coating, semi-gloss
    - 2) PPG: Pitt-Tech® Plus Int/Ext Semi-Gloss DTM Industrial Enamel 90-1210 series.
    - 3) BM: Ultra Spec HP DTM Acrylic Semi Gloss (HP29)

END OF SECTION 09 9133



## SECTION 101100 - VISUAL DISPLAY UNITS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Visual display board assemblies.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For visual display units.
  - 1. Include plans, elevations, sections, details, and attachment to other work.
  - 2. Show locations of panel joints
- C. Samples: For each type of visual display unit indicated.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; 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: 450 or less.

## 2.2 VISUAL DISPLAY BOARD ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ASI Visual Display Products.
  2. Claridge Products and Equipment, LLC.
  3. EVERWhite Whiteboards.
  4. Magna Visual Corp.
  5. Marsh Industries, Inc.
- B. Visual Display Board Assembly: factory fabricated.
  1. Assembly: markerboard .
  2. Corners: Square .
  3. Width: As indicated on Drawings .
  4. Height: As indicated on Drawings..
- C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.
  1. Color: White .
- D. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; standard size and shape .
  1. Factory-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.
  2. Aluminum Finish: Clear anodic finish.
- E. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, .
- F. Combination Assemblies: Provide manufacturer's standard exposed trim hidden spline between abutting sections of visual display panels.
- G. Marker Rail: Manufacturer's standard, extruded-aluminum marker rail with end stops, designed to hold accessories.
  1. Size: 3 inches high by full length of visual display unit.
  2. Aluminum Color: Match finish of visual display assembly trim.

## 2.3 MARKERBOARD PANELS

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
  1. Face Sheet Thickness: 0.021 inch uncoated base metal thickness.
  2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.

3. Hardboard Core: 1/4 inch thick; with 0.013-inch- thick, galvanized-steel sheet backing.
4. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

## 2.4 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. Hardboard: ANSI A135.4, tempered.
- C. Extruded Aluminum: ASTM B221, Alloy 6063.
- D. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

## 2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting height indicated on drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies:
  1. Adhere to wall surfaces with egg-size adhesive gobs at 16 inches o.c., horizontally and vertically.

END OF SECTION 101100

## SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Dimensional characters.
    - a. Cutout dimensional characters.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - 3. Show message list, typestyles, graphic elements, and layout for each sign at least **half size**.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

## 2.2 DIMENSIONAL CHARACTERS

- A. Cutout Characters: Characters with uniform faces; square-cut, smooth edges; precisely formed lines and profiles; and as follows:
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. ASI Sign Systems, Inc.
    - b. Gemini Signage; Gemini, Inc.
    - c. inpro Corporation.
    - d. Metal Arts.
    - e. Southwell Company (The).
  2. Character Material: Sheet or plate aluminum .
  3. Character Height: **As indicated on Drawings.**
  4. Thickness: **As indicated on Drawings.**
  5. Finishes:
    - a. Integral Aluminum Finish: Clear anodized .
  6. Mounting: Mount to bottom bar using concealed fasteners. Attach bar with countersunk flathead through fasteners into soffit below sign.

## 2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
  2. Exposed Metal-Fastener Components, General:
    - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
  3. Sign Mounting Fasteners:
    - a. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
- B. Adhesive: As recommended by sign manufacturer.

## 2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
1. Mill joints to a tight, hairline fit.
  2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  3. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
  4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets to match sign.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF DIMENSIONAL CHARACTERS

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Mounting Methods:
  1. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
  2. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position, so that signage is correctly located and aligned.
  3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101419

## SECTION 101423 - PANEL SIGNAGE

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Panel signs.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For panel signs.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements , including raised characters and Braille, and layout for each sign at least half size .

C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

#### 1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

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

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the ADA standards of the Federal agency having jurisdiction and ICC A117.1 .

## 2.2 PANEL SIGNS

- A. Panel Sign : Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
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. ASI Sign Systems, Inc.
    - b. Mohawk Sign Systems.
    - c. Seton Identification Products; a Brady Corporation company.
  2. Laminated Polycarbonate-Sheet Sign: Polycarbonate face sheet laminated to each side of phenolic base sheet to produce composite sheet.
    - a. Surface-Applied, Flat Graphics: Applied paint .
    - b. Surface-Applied, Raised Graphics: Applied Braille .
  3. Frame: Entire perimeter .
    - a. Material: PVC .
    - b. Profile: Beveled .
    - c. Corner Condition in Elevation: Mitered .
    - d. Finish and Color: As selected by Architect from manufacturer's full range .
  4. Mounting: Surface mounted to wall with concealed anchors .
  5. Surface Finish and Applied Graphics:
    - a. Photo-Image Graphics: Manufacturer's standard multicolor , 600-dpi halftone or dot-screen image.
    - b. Overcoat: .

## 2.3 PANEL-SIGN MATERIALS

- A. Acrylic Sheet: ASTM D4802, Type UVF (UV filtering).
- B. Polycarbonate Sheet: Coated, mar-resistant, UV-stabilized polycarbonate, with coating on both sides.
- C. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

## 2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
1. Use concealed fasteners and anchors unless indicated to be exposed.

## 2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.



2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
  3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  4. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
  5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
  4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
  2. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101423

## SECTION 102113 - PLASTIC TOILET COMPARTMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Solid-plastic toilet compartments configured as toilet enclosures.
2. Solid plastic urinal screens.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

B. Shop Drawings: For toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.
5. Show overhead support or bracing locations.

C. Samples for Initial Selection: For each type of toilet compartment material indicated.

1. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
2. Each type of hardware and accessory.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

## 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. 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: 200 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

### 2.2 SOLID-PLASTIC TOILET COMPARTMENTS.

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Scranton Partitions Hiny Hiders or comparable product by one of the following:
  - 1. Accurate Partitions Corp.; ASI Group.
  - 2. Bradley Corporation.
  - 3. General Partitions Mfg. Corp.
  - 4. Global Partitions; ASI Group.
  - 5. Hadrian Manufacturing Inc.
- B. Toilet-Enclosure Style: Floor anchored, overhead braced.
- C. Urinal-Screen Style: Wall hung.
  - 1. Size: 18" deep x 48" tall, mount bottom at 12" above floor.
- D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
  - 1. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
  - 2. Color and Pattern: Stainless Hammered.
- E. Pilaster Shoes: Manufacturer's standard design; stainless steel.
- F. Brackets (Fittings):
  - 1. Full-Height (Continuous) Type: Manufacturer's standard design; polymer.

- a. Polymer Color and Pattern: Matching panel.

## 2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.
  - 1. Material: Stainless steel.
  - 2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door.
  - 3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
  - 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
  - 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
  - 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

## 2.4 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221 .
- C. Brass Castings: ASTM B 584.
- D. Brass Extrusions: ASTM B 455.
- E. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- F. Stainless-Steel Castings: ASTM A 743/A 743M.

## 2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. 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.

- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
  - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch .
    - b. Panels and Walls: 1 inch .
  - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
    - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.

### 3.3 ADJUSTING

- A. 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 OF SECTION 102113

## SECTION 102213 - WIRE MESH PARTITIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Heavy-duty wire mesh partitions.

#### 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. Wire mesh partitions .
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Indicate clearances required for operation of gates.
- C. Delegated Design Submittals: For wire mesh partitions indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Delegated design engineer qualifications.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.5 QUALITY ASSURANCE

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available 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. American Wire Corporation.

2. Folding Guard, Incorporated.
3. G-S Company (The)
4. Jesco Industries.
5. Kenco Wire & Iron Products.
6. Newark Wire Works, Inc.
7. Wirecrafters, LLC.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wire mesh units.
- B. Structural Performance: Wire mesh units to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
  1. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft. at any location on a panel.
  2. Total load of 200 lbf applied uniformly over each panel.
  3. Concentrated load and total load need not be assumed to act concurrently.
  4. .
- C. Regulatory Requirements: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC A117.1 for doors and gates designated as accessible.

## 2.3 HEAVY-DUTY WIRE MESH PARTITIONS

- A. Mesh:
  1. 0.192-inch- diameter steel wire, resistance welded into 1-1/2-by-2-1/2-inch rectangular mesh.
- B. Vertical and Horizontal Panel Framing: 1-1/2-by-3/4-by-1/8-inch cold-rolled steel channels; with holes for 3/8-inch- diameter bolts not more than 12 inches o.c.
- C. Horizontal Panel Stiffeners: Two cold-rolled steel channels, 1 by 1/2 by 1/8 inch, bolted or riveted toe to toe through mesh.
- D. Top Capping Bars: 3-by-1-inch steel channels.
- E. Posts for 90-Degree Corners: 1-1/2-by-1-1/2-by-1/8-inch steel angles or tubes, with holes for 3/8-inch- diameter bolts aligning with bolt holes in vertical framing; with 1/4-inch steel base plates.
- F. Adjustable Corner Posts: Two 1-1/2-by-3/4-by-1/8-inch cold-rolled, steel channels or 2-by-2-by-0.075-inch steel tubes connected by steel hinges at 36 inches o.c. attached to posts; with

1/4-inch- diameter bolt holes aligning with bolt holes in vertical framing; with 1/4-inch steel base plates.

- G. Line Posts: 3-inch-by-4.1-lb or 3-1/2-by-1-1/4-by-1/8-inch steel channels; with 1/4-inch steel base plates.
- H. Way Intersection Posts: 2-by-2-by-0.075-inch steel tubes, with holes for 3/8-inch- diameter bolts aligned for bolting to adjacent panels; with 1/4-inch steel base plates.
- I. Floor Shoes: Metal, not less than 2 inches high; sized to suit vertical framing, drilled for attachment to floor, and with setscrews for leveling adjustment.
- J. Swinging Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/2-by-3/4-by-1/8-inch steel channels, banded with 1-1/2-by-1/8-inch flat steel bar cover plates on four sides, and with 1/8-inch- thick angle strike bar and cover on strike jamb.
  - 1. Hinges: Full-surface type, 3-1/2-by-3-1/2-inch steel, three per door; bolted, riveted, or welded to door and jamb framing.
  - 2. Closer: Manufacturer's standard.
  - 3. Cylinder Lock: Mortise type with cylinder specified in Section 087100 "Door Hardware" ; operated by key outside and lever inside; mounted in lower section of door.
  - 4. Electric Strike: Manufacturers standard electric strike. Basis-of-Design Assa Abloy HES 9400/9500/9600/9700.
  - 5. Wireless lockset by Owner's security vendor. Contact Bruce Pullen (609) 610-4937 [brucepullen@secuni.com](mailto:brucepullen@secuni.com) for wireless product information and templating requirements for doors and frames
- K. Accessories:
  - 1. Adjustable Filler Panels: 0.060-inch- thick, steel sheet; capable of filling openings from 2 to 12 inches.
  - 2. Wall Clips: Manufacturer's standard, cold-rolled steel sheet ; allowing up to 1 inch of adjustment.
- L. Finish: Powder-coated finish unless otherwise indicated.
  - 1. Color: Black.

## 2.4 MATERIALS

- A. Steel Wire: ASTM A510/A510M.
- B. Steel Plates, Channels, Angles, and Bars: ASTM A36/A36M.
- C. Steel Sheet: Cold-rolled steel sheet, ASTM A1008/A1008M, Commercial Steel (CS), Type B.
- D. Steel Pipe: ASTM A53/A53M, Schedule 40, unless another weight is indicated or required by structural loads.
- E. Steel Tubing: ASTM A500/A500M, cold-formed structural-steel tubing or ASTM A513/A513M, Type 5, mandrel-drawn mechanical tubing.



- F. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with G60 zinc (galvanized) or A60 zinc-iron-alloy (galvannealed) coating designation.
- G. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.
- H. Post-Installed Anchors: Capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components are zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. , and nuts, ,
- I. Power-Driven Fasteners: ICC-ES AC70.
- J. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting."
- K. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, complying with MPI#79.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- L. Zinc-Rich Primer: Compatible with topcoat, complying with SSPC-Paint 20 or SSPC-Paint 29.
- M. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

## 2.5 FABRICATION

- A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.
  - 1. Fabricate wire mesh items to be readily disassembled.
  - 2. Welding: Weld corner joints of framing and finish sand .
- B. Heavy-Duty Wire Mesh Partitions: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.
  - 1. Mesh: Weld mesh to framing.
  - 2. Framing: Fabricate framing with mortise-and-tenon corner construction.
    - a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.
    - b. Fabricate three- way intersections using manufacturer's standard connecting clips and fasteners.
    - c. Fabricate partition and door framing with slotted holes for connecting adjacent panels.
  - 3. Fabricate wire mesh partitions with 3 to 4 inches of clear space between finished floor and bottom horizontal framing.
  - 4. Fabricate wire mesh partitions with bottom horizontal framing flush with finished floor.
  - 5. Doors: Align bottom of door with bottom of adjacent panels.

- a. For doors that do not extend full height of partition, provide transom over door, fabricated from same mesh and framing as partition panels.
6. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.

## 2.6 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean items of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- D. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on powder-coat finish, suitable for use indicated, with a minimum dry film thickness of 2 mils .
  1. Color and Gloss: Black low sheen. .

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF WIRE MESH PARTITIONS

- A. Anchor wire mesh partitions to floor with 3/8-inch- diameter, postinstalled expansion anchors at 12 inches o.c. through anchor clips located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.
  1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.
- B. Anchor wire mesh partitions to floor with 3/8-inch- diameter, postinstalled expansion anchors at 12 inches o.c. through floor shoes located at each post and corner. Adjust wire mesh partition posts in floor shoes to achieve level and plumb installation.
  1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.
- C. Anchor wire mesh partitions to walls at 12 inches o.c. through back corner panel framing and as follows:
  1. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

- D. Secure top capping bars to top framing channels with 1/4-inch- diameter, "U" bolts spaced not more than 28 inches o.c.
- E. Provide line posts at locations indicated or, if not indicated, as follows:
  - 1. On each side of door openings.
  - 2. For partitions that are 7 to 9 ft. high, spaced at 15 to 20 ft. o.c.
- F. Where standard-width wire mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.
- G. Install doors complete with door hardware.
- H. Weld or bolt sheet metal bases to wire mesh partitions .
- I. Bolt accessories to wire mesh partition framing.

### 3.2 REPAIR

- A. Repair Painting:
  - 1. Wire brush and clean rust spots, welds, and abraded areas immediately after installation, and apply repair paint with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

### 3.3 ADJUSTING

- A. Adjust gates to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Verify that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION 102213

## SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Public-use washroom accessories.
  - 2. Underlavatory guards.

#### 1.2 ACTION SUBMITTALS

- A. Product data.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

#### 2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Accessories will be supplied by Owner and installed by Contractor except accessories specified in this section which will be supplied and installed by Contractor.
- B. Grab Bar :
  - 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. ASI-American Specialties, Inc.
- b. Bobrick Washroom Equipment, Inc.
- c. Bradley Corporation.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. OD: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings .

C. Mirror Unit :

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. ASI-American Specialties, Inc.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
2. Frame: Stainless steel channel .
  - a. Corners: Mitered and mechanically interlocked .
3. Size: As indicated on Drawings .
4. Hangers: Manufacturer's standard rigid, tamper and theft resistant .

D. Coat Hook:

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. ASI-American Specialties, Inc. 7301-S
  - b. Bobrick Washroom Equipment, Inc. B76717.
  - c. Bradley Corporation. 9114.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel.
  - a. Finish: No. 4 finish (satin).

## 2.3 UNDERLAVATORY GUARDS

A. Underlavatory Guard :

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. Buckaroos, Inc.
  - b. Plumberex Specialty Products, Inc.
  - c. Truebro; IPS Corporation.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

## 2.4 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories in accordance with 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.
  - 1. Remove temporary labels and protective coatings.
- A. Grab Bars: Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

END OF SECTION 102800

## SECTION 104413 - FIRE PROTECTION CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Fire-extinguisher cabinets for portable fire extinguishers.
2. Fire valve cabinets.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fire-protection cabinets.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.4 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

### PART 2 - PRODUCTS

#### 2.1 FIRE-EXTINGUISHER CABINET FEC

A. Cabinet Type: Suitable for fire extinguisher.

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. Babcock-Davis.
  - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
  - c. Larsen's Manufacturing Company.
  - d. Nystrom, Inc.
  - e. Potter Roemer LLC; a Division of Morris Group International.

B. Cabinet Construction: Nonrated .

C. Cabinet Material: Stainless steel sheet.

- D. Recessed Cabinet:
  - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
- E. Cabinet Trim Material: Stainless steel sheet .
- F. Door Material: Stainless steel sheet .
- G. Door Style: Vertical duo panel with frame .
- H. Door Glazing: Tempered float glass (clear) .
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- J. Accessories:
  - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
  - 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated .
    - a. Identify fire extinguisher in fire-protection cabinet with the words " FIRE EXTINGUISHER ."
      - 1) Location: Applied to cabinet door .
      - 2) Application Process: Decals .
      - 3) Lettering Color: Black .
      - 4) Orientation: Vertical .
  - 3. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
- K. Materials:
  - 1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.
    - a. Finish: ASTM A480/A480M No. 4 directional satin finish, .
  - 2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear) .

## 2.2 VALVE CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
  - 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. Babcock-Davis.
    - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    - c. Larsen's Manufacturing Company.
    - d. Nystrom, Inc.
    - e. Potter Roemer LLC; a Division of Morris Group International.
- B. Cabinet Construction: Nonrated .



- C. Cabinet Material: Steel sheet.
- D. Recessed Cabinet:
  - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
- E. Cabinet Trim Material: Steel sheet .
- F. Door Material: Steel sheet .
- G. Door Style: Full glass.
- H. Door Glazing: Tempered float glass (clear) .
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- J. Size: Inside box, 18 x 18 x 8 inches.
- K. Materials:
  - 1. Cold Rolled Steel: ASTM A1000. Commercial steel (CS), Type D.
  - 2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear) .

## 2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Identification: Apply decals at locations indicated.
- E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413

## SECTION 104416 - FIRE EXTINGUISHERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.5 COORDINATION

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Six years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

#### 2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.

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. Babcock-Davis.
  - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
  - c. Kidde; Carrier Global Corporation.
  - d. Larsen's Manufacturing Company.
  - e. Nystrom, Inc.
  - f. Potter Roemer LLC; a Division of Morris Group International.
2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

- B. Multipurpose Dry-Chemical Type FE : UL-rated 10 lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

## 2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

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. Ansul; brand of Johnson Controls International plc, Building Solutions North America.
  - b. Babcock-Davis.
  - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
  - d. Kidde; Carrier Global Corporation.
  - e. Larsen's Manufacturing Company.
  - f. Potter Roemer LLC; a Division of Morris Group International.

- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
  - a. Orientation: Vertical .

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
  1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated, in each indicated fire protection cabinet, and in compliance with requirements of authorities having jurisdiction.

- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
  - 1. Mounting Height: Top of fire extinguisher to be at 42 inches above finished floor.

END OF SECTION 104416

## SECTION 122413 - ROLLER WINDOW SHADES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

#### 1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

#### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

### PART 2 - PRODUCTS

#### 2.1 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

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. Draper, Inc.
2. Hunter Douglas Architectural.
3. MechoShade Systems, LLC.
4. OEM Blinds LLC.
5. QMotion; Legrand Building Control Systems (BCS); Legrand, North America, LLC.

- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
  - 1. Chain-Retainer Type: Clip, jamb mount .
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
  - 1. Roller Drive-End Location: Right side of interior face of shade .
  - 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller .
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- F. Shadebands:
  - 1. Shadeband Material: Light-filtering fabric .
  - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - a. Type: Enclosed in sealed pocket of shadeband material .
    - b. Color and Finish: As selected by Architect from manufacturer's full range .
- G. Installation Accessories:
  - 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
  - 2. Endcap Covers: To cover exposed endcaps.
  - 3. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
  - 4. Installation Accessories Color and Finish: As selected from manufacturer's full range .

## 2.2 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701 . Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
  - 1. Source: Roller shade manufacturer .
  - 2. Type: Woven polyester and PVC-coated polyester .
  - 3. Weave: Mesh .
  - 4. Thickness: 0.034 inch.
  - 5. Weight: 19.9 oz/yd sq. .
  - 6. Roll Width: As required for full existing window width without a vertical seam .
  - 7. Orientation on Shadeband: Up the bolt .
  - 8. Openness Factor: 1 percent.
  - 9. Color: As selected by Architect from manufacturer's full range .

## 2.3 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
  - 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
  - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4 provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

## PART 3 - EXECUTION

### 3.1 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
  - 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
- B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- C. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- D. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

## SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Plastic-laminate-clad countertops.
  - 2. Accessories.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For plastic-laminate-clad countertops.
  - 1. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples: Plastic laminates in each type, color, pattern, and surface finish required.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For the following:
  - 1. Composite wood products.
  - 2. High-pressure decorative laminate.
  - 3. Adhesives.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program .

#### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
  - 1. Shop Certification: AWI's Quality Certification Program accredited participant .
- B. Installer Qualifications: Fabricator of products AWI's Quality Certification Program accredited participant.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install wood countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.



- B. Environmental Limitations with Humidity Control: Do not deliver or install wood countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.
  - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grades specified.
- B. Grade: Custom .
- C. High-Pressure Decorative Laminate: ISO 4586-3, Grade HGS .
  - 1. Basis-of-Design: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following.
    - a. Formica Corporation.
    - b. Laminart LLC.
    - c. Nevamar Company, LLC.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. As selected by Architect from manufacturer's full range in the following categories:
    - a. Solid colors, matte finish.
    - b. Solid colors with core same color as surface, matte finish.
    - c. Wood grains, matte finish with grain running parallel to length of countertop.
    - d. Patterns, matte finish.
- E. Edge Treatment: Same as laminate cladding on horizontal surfaces .
- F. Core Material: MDF made with exterior glue.
- G. Core Material at Sinks: exterior-grade plywood.
- H. Core Thickness: 3/4 inch.
  - 1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

### 2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.

1. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
2. Softwood Plywood: DOC PS 1.

## 2.3 ACCESSORIES

A. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Outside Diameter: 2 inches.
2. Color: Black,

## 2.4 MISCELLANEOUS MATERIALS

A. Adhesives: Do not use adhesives that contain urea formaldehyde.

B. Adhesive for Bonding Plastic Laminate: Type I waterproof type as selected by fabricator to comply with requirements.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

C. Installation Adhesive:

1. Adhesives shall have a VOC content of 70 g/L or less.

## 2.5 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:

1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
  2. Seal edges of cutouts by saturating with varnish.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
1. Secure field joints in countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches variation from a straight, level plane.
  2. Secure backsplashes to walls with adhesive.
  3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.
- F. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 123623.13

## SECTION 123661.16 - SOLID SURFACING COUNTERTOPS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Solid surface material countertops.
  2. Solid surface material backsplashes.
  3. Solid surface material end splashes.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples: For each type of material exposed to view.

### PART 2 - PRODUCTS

#### 2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. DuPont; DuPont de Nemours, Inc.
    - b. Formica Corporation.
    - c. Meganite Inc.
    - d. Swan Surfaces LLC (Swanstone).
    - e. Wilsonart LLC.
  2. Type: Provide Standard type unless Special Purpose type is indicated.
  3. Colors and Patterns: As selected by Architect from manufacturer's full range.
- B. Composite Wood Products: Verify products are made without added urea formaldehyde.
- C. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
- D. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

#### 2.2 FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom .
- B. Countertops:
  1. 3/4-inch- thick, solid surface material with front edge built up with same material.
  2. .
- C. Backsplashes: 3/4-inch thick, solid surface material.
- D. Joints:
  1. Fabricate countertops without joints.
- E. Cutouts and Holes:
  1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

## 2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
  1. Verify adhesives have a VOC content of 70 g/L or less.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer.
- B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- C. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions.
- D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.
- F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- G. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

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## DIVISION 22 - PLUMBING

### SECTION 22 05 00 - STANDARD CONDITIONS FOR PLUMBING

#### PART 1 - GENERAL

##### 1.01 REFERENCE

- A. Requirements established within the portions of this project manual titled Division 1, General Requirements are collectively applicable to the work of this section.
- B. Instructions to Bidders, Special Conditions and addenda as issued are part of this specification.
- C. Plumbing drawings along with all other project drawings and specifications represent the work of this section.
- D. Drawings, Contract, General Conditions and Supplementary Conditions form a part of this section, by reference thereto and shall have the same force and effect as if printed herewith in full. Failure to review these sections shall not relieve the Contractor of his responsibility to fully comply with the terms therein.

##### 1.02 SCOPE

- A. Provide labor, material, equipment and supervision necessary to install complete operating plumbing systems as indicated on the drawings and specified herein, including all work at the site and within the proposed construction areas to accomplish the required work.
- B. It shall be the contractor's responsibility to coordinate his work and the work of his subcontractors to insure that all the work is covered. He shall designate who is responsible for various portions of work which may overlap so that there is complete coverage of all required work. It is the position of the owner and the A/E that all work is the responsibility of the mechanical contractor within this division of the work.
- C. Contractor shall provide all demolition necessary to remove and replace, repair, install new or modify existing work whether it be walls, floors, ceilings, structure, mechanical or electrical required to install his work. Contractor shall replace all work to leave in a finished condition.
- D. All work shown on the drawings and not expressly mentioned in the specifications and all work specified but not shown on the drawings, but necessary for the proper execution of same shall be performed by the contractor. It is not the intent of the drawings and specifications to describe every feature and detail of the work.
- E. No additions to the contract amount will be approved for any materials, equipment, or labor to perform additional work unless it can be clearly shown to be beyond the scope and intent of the drawings and specifications.
- F. Plumbing contractor's scope of work shall include but not be limited to the following:
  - 1. Domestic water system and insulation (See Section 22 11 16, 22 07 00 and 22 40 00).
  - 2. All other work in Division 22.
  - 3. Roof penetrations for plumbing work.
  - 4. Demolition of existing work to accommodate new work.

5. Repair existing areas affected by new construction. Patch, repair and finish to match existing.

#### 1.03 REGULATIONS, CODES, AND STANDARDS

- A. Work shall be performed in accordance with the latest adopted codes, amendments, regulations and ordinances of the authorities having jurisdiction. Observe all safety regulations including the requirements of OSHA.
- B. Obtain and pay for all permits, connection charges, inspections, and certificates required to complete the work.
- C. Latest editions of any referenced standards shall govern.
- D. Contractor shall arrange and pay for all tests and inspections specified herein or required by above agencies and furnish required certificate of inspection to owner.
- E. Where the contract documents are more stringent but not in conflict with the applicable codes, the more stringent requirements shall be followed.

#### 1.04 SUBMISSIONS

- A. The procedure for submissions of shop drawings shall be as specified in Division 1, or as a minimum, as indicated below.
- B. Furnish submissions of shop drawings and samples of materials and equipment as indicated in these sections, on the drawings, or as directed by the A/E. Submissions will be made in a timely fashion such that adequate time exists to review the drawings, or material, and arrive at the site in accordance with the project schedule.
- C. Submissions will not be accepted with work defined as "By Others". Identify contractor by name and with his approval so indicated. Submissions are required prior to purchasing, fabrication, or installation of any material or equipment. Submissions shall be reviewed and certified by the submitting contractor that they are in accordance with the project documents.
- D. When requested by the engineer, shop drawings shall be required to be submitted to designated agencies for review and approval prior to submission to the engineer.
- E. Contractor shall arrange and pay for all tests and inspections specified herein or required by above agencies and furnish required certificate of inspection to owner.
- F. Contractor to forward a copy of submittals which have electrical requirements to the Electrical Contractor (EC) for coordination of voltage, amperage, and phase. Response to be received from EC prior to ordering of equipment by mechanical contractor.
- G. Submissions shall include warranties by the manufacturer for equipment being provided. Submissions for commonly related items such as fixtures, trim, carriers, drains shall be combined in a single brochure with all items being furnished clearly identified.
- H. Shop drawings and submittals shall be checked and stamped by the contractor before submitting. They shall conform to measurements made at the site, the contract requirements, and coordinated with all other trades.
- I. Specific models in catalog sheets must be identified as well as all options, voltages, phases, etc. identified so as to be clear on what is being provided.
- J. Contractor and manufacturers shall be responsible for all physical characteristics of the equipment and field verify with final locations, coordinate with floor plans, confirm service access, clearances, confirm equipment arrangements, electrical disconnect clearances, and pathways/travel/access to the final equipment installation locations. Submission of equipment shop drawing will be deemed evidence of compliance with this requirement. If no shop drawing is submitted, contractor shall be fully responsible for a complete installation

and assumes all related costs that affects the contractor and other trades.

- K. To aid in the preparation of submittals or shop drawings, the engineer can provide the electronic files for use by the contractor. The electronic files will be provided upon execution of the engineer's electronic file release contract prepared specifically for this project. The electronic files will be released in the format used by the architect and engineer to design the project. If this file format is not compatible with the contractor's needs, additional charges for providing the changes to the requested file format may be necessary at \$150/hr. billable to the contractor.

#### 1.05 SITE INSPECTION

- A. Visit site, inspect and become aware of all conditions which may affect the work. Investigate utilities, protection requirements for adjacent facilities, storage locations, and access to the construction area.
- B. Submission of bid will be deemed evidence of having complied with this request. Contractor may not request additional costs for existing conditions which were evident from inspection of the site.

#### 1.06 SUBSTITUTIONS

- A. Material and equipment specified shall be deemed as that which the bidder's quotation represents the contractor.
- B. Once bids are accepted only that material and equipment listed in the specifications or added by addenda shall be acceptable. Substitution information for inclusion in an addenda must be received by the A/E at least 10 days prior to bid opening. If acceptable, an addenda will be issued which will add the additional acceptable manufacturers or materials and be available for all contractors to consider. It shall be a basic premise that a contractor is a lowest bidder because he utilized substituted materials or equipment as opposed to specified materials or equipment.
- C. If the contractor submits alternate equipment, manufacturers, systems, methods, or materials, not specifically identified in the specifications, additional review and investigation time may be required by the engineer. If the engineer determines additional review time is required because of the substitution, then this will be a billable service by the engineer at the rate of \$150.00/hr. for such services. Also, billable will be any redesign time and revisions to drawings should they be necessary for incorporation into the work. Services will be billable to the contractor making such substitutions and will be payable prior to approval or rejection.
- D. Contractor and manufacturers shall be responsible for all physical characteristics of the equipment and field verify with final locations, coordinate with floor plans, confirm service access, clearances, confirm equipment arrangements, electrical disconnect clearances, and pathways/travel/access to the final equipment installation locations. Submission of equipment shop drawing will be deemed evidence of compliance with this requirement. If no shop drawing is submitted, contractor shall be fully responsible for a complete installation and assumes all related costs that affects the contractor and other trades.

#### 1.07 DRAWINGS AND SPECIFICATIONS

- A. The drawings are generally diagrammatic and necessary field coordination and adjustment must be provided by the contractor prior to installation. Such deviations to the work to allow

for coordination shall be kept to a minimum and any such deviations shall be at no extra cost.

- B. When a conflict or contradiction exists either between drawings and specs or between specs or between different drawings or details, the more stringent shall apply.
- C. Drawings and specifications are intended to be taken as a whole and each is to supplement the other. It is not intended that all work must be both shown on drawings and specified in the specifications.
- D. An item shown on the drawings and not indicated in the specifications is to be understood to be required for the project. An item specified and not shown on the drawings is to be understood to be required for the project.
- E. The architects or engineer's interpretation of the documents shall be binding upon the contractor. If a question arises, the contractor shall ask for an interpretation prior to bidding and an answer shall be issued as an addendum to all bidders.
- F. If a question arises after bidding the A/E interpretation shall govern.

#### 1.08 MEASUREMENTS

- A. Before ordering materials or commencing with any work, the contractor shall verify all measurements at the building. Coordination of equipment, materials, spaces, and dimensions are the responsibility of the contractor.

#### 1.09 PROGRESS SCHEDULE

- A. Provide a project schedule which shall show start, sequence of each type of work, milestone schedule, and completion of each type of work, with overall completion date.

#### 1.10 COST SCHEDULE

- A. Provide a detailed cost breakdown indicating labor and material amounts for various types of work.
- B. AIA forms are required for this submission.

#### 1.11 COMPLETION

- A. The contractor shall deliver to the owner, with his request for final payment, copies of all manufacturer's guarantees, equipment instructional manuals, a complete set of all final shop drawings, catalog cuts, service contracts, and other items as may be required elsewhere in the documents.

#### 1.12 OFFICE

- A. The contractor shall set up his job office (desk) where directed by the owner.

#### 1.13 STORAGE

- A. Material shall be stored only where directed by the owner.

#### 1.14 SANITARY

- A. The contractor will at his own expense, provide and maintain in a sanitary condition, a portable chemical toilet.
- B. Toilet will be located where directed by the owner.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. All material shall be new and of present day manufacture.
- B. All material and equipment shall be in conformance with accepted trade standards.
- C. Whenever equipment or material is referred to in the singular, such as "the fan", it shall be deemed to apply to as many such items as may be necessary to complete the installation.
- D. The word "provide" means "furnish and install complete, tested, and adjusted as necessary with all accessories, covers, escutcheons". The word "piping" means pipe, fitting, controls, valves and hangers as required for a complete system.

### **2.02 EQUIPMENT START UP**

- A. Verify that equipment is operating within warranty requirements.
- B. Advise owner and A/E at least two days prior.
- C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to A/E.

### **2.03 OPERATING INSTRUCTIONS AND MANUALS**

- A. Properly and fully instruct owner's personnel in the operation and maintenance of all systems and equipment.
- B. Insure that the owner's personnel are familiar with all operations to carry on required activities.
- C. Such instruction shall be for each item of equipment and each system as a whole.
- D. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, wiring diagrams, control sequences, service requirements, piping diagrams, names and addresses of vendors, suppliers and emergency contacts. Three manuals shall be provided.
- E. Provide to the owner any special tools necessary to operate any of the equipment.

### **2.04 DRAIN PANS**

- A. All water heaters mounted above the floor shall be provided with drain pans. Drain to suitable discharge point acceptable to owner and A/E. To be visible outfall.
- B. Drains shall slope down in direction of flow at 1" per 10 feet.

### **PART 3 - EXECUTION**

#### **3.01 PROTECTION**

- A. Plug or cap open ends of piping systems and conduit.
- B. Stored materials shall be covered to prevent damage by inclement weather, sun, dust, or moisture.
- C. Protect all installed work until accepted in place by the owner. Cover plumbing fixtures.
- D. Do not install plates, polished metal escutcheons, and other finished devices until masonry, tile, and painting operations are complete or protect otherwise.
- E. Protect all existing or new work from operations which may cause damage such as hauling, welding, soldering, painting, insulating, and covering.

#### **3.02 WORKMANSHIP**

- A. Install all work neat, trim, and plumb with building lines.
- B. Install work in spaces allocated.
- C. Cutting and patching shall be performed by skilled tradesmen normally employed for the work involved.

#### **3.03 EXCAVATION, SHORING, PUMPING, BACKFILLING**

- A. Perform all excavation required to install the work. Deposit excavated material so as not to create a slide hazard.
- B. No work shall be placed on rock. Cushion with 6 " layer of crushed stone.
- C. Protect tree roots with burlap covering and maintain moist until backfilled.
- D. Base estimates on excavation which will include earth, sand, clay, rubbish, debris, and all other materials up to one cubic yard in size. Boulders or rock larger than one cubic yard which need to be broken up with pneumatic equipment or explosives will be separately negotiated at the time of discovery with the owner and A/E. Do not proceed with rock excavation until an agreement is reached.
- E. Maintain excavations free of water.
- F. Shore excavations to prevent cave-in in accordance with OSHA regulations and to prevent strains on work put in place until ready to receive backfill.
- G. Backfill with clean material and pneumatically tamp in 8" layers. Remove excess material, including rock, from site or as directed by the A/E.
- H. Backfill piping trenches within 18" of footings, columns, piers, or grade beams, with concrete. Protect piping from direct contact and adherence to concrete.
- I. Return to original condition any areas disturbed for excavation.

#### **3.04 FASTENERS, HANGERS, AND SUPPORTS**

- A. Furnish and install all hangers and supports required to suspend, mount, or hang the work.
- B. Furnish and install all miscellaneous steel angles, channels, beams, clips, brackets, and anchors to hang or support the work. Provide submissions for review.
- C. Install concrete inserts before concrete is poured.
- D. Drilled inserts shall not be loaded to more than 1/4 rated capacity with a minimum of 200 lbs.
- E. Powder driven fasteners shall not be allowed for piping larger than 2", or for equipment.

- F. When used they shall not be loaded more than 1/8 rated capacity with a minimum of 200 lbs. All hangers, miscellaneous steel, braces, and supports shall be galvanized, cadmium plated, or painted with corrosion resistant primer and finish coat of epoxy enamel.
- G. Piping shall be supported from adjustable clevis type hangers with insulation pipe saddles at not more than 8 foot centers up to 1 1/4" dia. and 10 foot centers above 1 1/4" dia. Piping shall not support other piping.
- H. Support vertical piping at floor levels. Piping shall have split rings.
- I. Provide and install lintels where required for mechanical work and not indicated on architectural or structural drawings.
- J. Furnish steel framing for roof openings and floor openings. Submit details for review.

### 3.05 SLEEVES

- A. All piping passing through floors or walls shall have sleeves unless holes are cored. Sleeves shall be 16 gage galvanized steel in non-bearing walls, 10 gage galvanized steel for bearing walls, and schedule 40 galvanized pipe in floors. Sleeves shall accommodate insulation. This shall not apply to sprinkler piping.
- B. Sleeves passing through foundation walls not exposed to interior spaces or sleeves passing through slab on grade may be schedule 40 PVC.
- C. Wall sleeves shall finish flush with wall.
- D. Floor sleeves shall extend 1 inch above floor.
- E. Sleeves in walls between interior spaces and unexcavated, exterior, crawl, or backfilled spaces shall be made watertight with "Link-Seal" modular wall and casing seal. Casing shall be schedule 40 galvanized pipe with anchor flange.

### 3.06 PLATES

- A. Furnish and install chrome plated plates wherever piping passes into finished areas.
- B. Plates shall be securely fastened to piping or building construction.
- C. Floor plates shall cover one inch floor extension.

### 3.07 OFFSETS, TRANSITIONS, MODIFICATIONS

- A. Furnish and install all offsets necessary to install the work and to provide clearance for the other trades.
- B. Maintain adequate headroom and clearance as directed by the A/E.
- C. Ductwork transitions necessary to accommodate available space or clearance requirements shall be contract requirements.
- D. Incidental modifications necessary to the installation of the systems shall be made as necessary and at the direction of the A/E.
- E. Rises and drops of piping systems shall be provided as required and where directed to allow for clearances to other construction. Drains shall be installed at no additional cost to the owner. The contractor shall allow for such occurrences in his bid.
- F. Piping and equipment shall be so arranged as to not pass in front of windows, doors, access panels, access doors, coil removal or filter removal space or service clearance areas. Do not install within 3'-0" clearance of electrical panel fronts.

### 3.08 RECESSES



- A. Furnish information to the general contractor as to sizes and locations of recesses required to install panels, boxes, grilles, and other equipment or devices which are to be recessed into walls.
- B. Make offsets or modifications as required to suit final locations.

### 3.09 EQUIPMENT SETTING

- A. Furnish and install as a minimum, a 4" thick concrete pad beneath all floor mounted equipment in mechanical rooms, boiler rooms, or equipment rooms, or outside on grade. This shall not apply to residential installations of water heaters unless detailed on drawings or specified elsewhere.
- B. Furnish and install as a minimum, spring vibration isolators under any equipment 5 HP and over and rubber-in-shear vibration isolation under all equipment less than 5 HP. This shall apply to residential installations.
- C. Reinforce concrete with No. 4 rods 12" on centers both ways.
- D. Pad to have 3/4" dowels into concrete at 1 per 4 square feet.

### 3.10 LABELING

- A. All equipment shall be provided with permanent black laminated white core labels with 3/8" letters.

### 3.11 FLASHING AND COUNTER-FLASHING

- A. Roof drains and overflow drains shall have counter-flashing fittings. General contractor shall provide flashing.
- B. Piping and conduit through the roof shall be flashed by the General Contractor. This contractor shall furnish counterflashing.

### 3.12 ACCESS

- A. Locate all equipment, valves, devices and controllers which may need service in accessible places.
- B. Where access is not available; access panels shall be provided. Furnish prime painted steel access doors to the General Contractor for installation.
- C. Access doors shall be 16 gauge frames and 22 gauge steel door. Access doors in fire rated walls shall have a "B" label for 1 ½ hours.
- D. Maintain clearances for tube removal, coil pulls, and filter removal.

### 3.13 WIRING

- A. Power wiring shall be provided by the Division 16 Electrical Contractor. This contractor shall furnish all 3 phase starters, pushbuttons, and controllers necessary to operate the equipment. The Electrical Contractor shall store and install the electrical devices and furnish and install the power wiring.
- B. Control wiring shall be furnished and installed under Division 26 portion of the work. Wiring for controls is control wiring whether it is line voltage or low voltage.
- C. All wiring shall be in accordance with the NEC.
- D. Pushbuttons shall be maintain-contact type.

- E. Refer to the electrical specifications for wiring methods.
- F. Plenum rated cable is required for control wiring.

### 3.14 GUARANTEE

- A. All work shall be guaranteed to be free from defects for a period of one year of operation from date of acceptance by the owner unless otherwise specified. Material and labor for first year warranty is to be provided.
- B. Guarantee shall be extended for all non-operational periods due to failure within the guarantee period.
- C. Compressor system components shall be provided with a 5 year factory warranty. Material only for years 2 through 5 is required.

### 3.15 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver material and equipment in manufacturer's original cartons or on skids.
- B. Store material in dry enclosures or under protective coverings out of way of work progress.
- C. Handle so as to prevent damage to product or any surrounding material.

### 3.16 MANUFACTURERS' NAMES

- A. Manufacturers' names are included herein to establish those suppliers who may provide products for this project subject to the requirements of the specifications. Although a manufacturer's name may appear as an acceptable supplier it is not understood that a standard product is acceptable. Products must also meet the technical, performance, and physical requirements of the project as well as being named in the specification. Any deviations from this must be acknowledged at bid time by the supplier and he shall be solely responsible for any and all costs associated with the application of his product in the project.
- B. A design cannot be prepared which accommodates the installation of all suppliers and is not intended to do so. If certain modifications must be made to accommodate one particular supplier's equipment it shall be considered the contractor's responsibility to arrange for such accommodations and be financially responsible for same.

### 3.17 AS-BUILT DRAWINGS

- A. At the completion of the work the contractor shall furnish a reproducible as-built drawings to the A/E for approval. The drawings shall indicate all work installed and its actual size and location. If acceptable, the A/E will submit the as-built drawings to the owner as record drawings. If not acceptable, the A/E will return the drawing to the contractor to make corrections as required. The contractor will resubmit for approval.
- B. The as-built drawings shall indicate measured dimensions of underground lines and other concealed work.
- C. To aid in the preparation of as-built drawings, the engineer can provide the electronic files for use by the contractor. The electronic files will be provided upon execution of the engineer's electronic file release contract prepared specifically for this project. The electronic files will be released in the format used by the architect and engineer to design the project. If this file format is not compatible with the contractor's needs, additional charges for providing the changes to the requested file format may be necessary at \$150/hr. billable to the contractor.

### 3.18 PENETRATION SEALING

- A. All penetrations of Natatorium walls, fire walls, smoke walls, and floors by pipes or wiring shall be sealed to prevent the flow of gasses or smoke.
- B. The sealant shall be foamed in place between the penetrant and the adjacent floor or wall with DOW Corning RTV foam or equivalent by 3M, Hilti, or Chase foam.
- C. The installation shall meet the approval of the authority having jurisdiction.
- D. Penetrations through rated surfaces shall have a UL rating equivalent to the adjacent surfaces.

### 3.19 CUTTING AND PATCHING INTERIOR SURFACES

- A. Respective contractor shall install all hangers, supports, pipe sleeves in floors, walls, partitions, ceilings and roof slabs as construction progresses to permit their work to be built into place and to eliminate unnecessary cutting of construction work.
- B. All cutting of concrete, or other material for the passage of piping through floors, walls, partitions and ceiling shall be done by the respective contractor where necessary to install his work. Respective contractor will close all such openings around piping with materials equivalent to that removed. All exposed surfaces shall be left in suitable condition for refinishing without further work.
- C. Contractor shall patch and repair any existing openings created by the demolition work in floors, walls, partitions, and ceilings not being reused for the new construction.

### 3.20 INVERTS AND ELEVATIONS

- A. Indicated inverts and elevations of existing utilities are approximate and based on the best information available.
- B. Upon award of contract, contractor shall verify in the field all such information and report any discrepancies before proceeding with work. Contractor shall be responsible for extra work caused by his failure to verify inverts and elevations.

### 3.21 CONNECTIONS TO EQUIPMENT FURNISHED BY OTHERS

- A. Furnish and install final connections to equipment furnished in other parts of the specification or furnished by the owner. Provide drainage connections, vent connections, water connections, fuel gas connections, gas connections to the fixtures or equipment. Plumbing connections shall include valved supplies and trapped waste connections.

### 3.22 CONNECTIONS TO EXISTING SYSTEMS

- A. The contractor shall be responsible for connecting new systems to existing systems.
- B. Arrange for outages with the owner.
- C. Contractor shall shut down and drain existing systems.
- D. Contractor shall cut in, weld, solder, or thread, and make connections compatible with existing systems.
- E. Provide new valves at connections to existing systems.
- F. Contractor shall refill existing and fill new systems.
- G. Contractor shall purge air from systems, both new and existing.
- H. Contractor shall place existing systems back into operation.

- I. Contractor shall repair and replace any insulation damaged or removed during connection procedures.

### 3.23 COORDINATION DRAWINGS

- A. Provide 3/8" = 1'-0" scale drawings showing all coordinated ductwork, piping, conduit, and equipment of all trades.
- B. The sheet metal shop drawings may be used as the basis of these drawings.
- C. Show ductwork, walls, beams, steel, drainage piping, domestic water piping, HVAC piping, sprinkler piping, light fixtures, electrical conduit and equipment.
- D. Contact other disciplines and obtain information to identify fully coordinated systems.
- E. Submit for review and approval to the A/E.
- F. Provide all dimensional data and necessary clearances to other trades for installation of fixtures and equipment within casework and counter tops.
- G. Work shall not proceed until coordination is completed and all conflicts, issues, sequences etc., are resolved.

### 3.24 WELDING

- A. All electric power for arc welding shall be supplied by the contractor performing the work.

### 3.25 VEHICLES

- A. Vehicle access to the site will be as directed by the owner.

### 3.26 RUBBISH DISPOSAL

- A. Burning of debris on the site shall not be permitted. All debris, refuse, and waste shall be removed from the premises at regular intervals. No accumulation shall be permitted.

### 3.27 PROTECTION

- A. Maintain all public walks and access ways.
- B. Erect and maintain barricades, warning signs, and other protective means as may be directed by the owner for protection of all persons and property from injury or damage.

### 3.28 SCAFFOLDING

- A. The contractor shall at his own expense, install, operate, protect, and maintain temporary services such as scaffolding, material hoists, access walks, etc., as may be required.

### 3.29 UTILITIES

- A. The contractor may use the existing water and electric power for temporary construction needs.
- B. The owner will direct where these services may be tapped.
- C. Those services that are used during construction, but are to remain, shall be refurbished to as new condition before turning back to the owner.

**3.30 CLEANUP**

- A. Remove all visible temporary tags or labels as well as any protective coverings and wrappings from fixtures and equipment.
- B. Remove all spots, stains, soil, paint, spackle, and other foreign matter from all finished work.
- C. Clean and polish all plumbing fixtures.
- D. Remove all trash and debris from the premises.

**3.31 MOUNTING HEIGHTS**

- A. Contractor to coordinate all mounting heights with all trades and architect prior to rough-in.

**3.32 WORK COMPLETION**

- A. The contractor shall promptly correct work rejected by the engineer failing to conform to the requirements of the contract documents, whether discovered before or after substantial completion and whether or not fabricated, installed or completed. Costs of correcting such rejected work, including additional testing and inspections and compensation for the engineer's services and expenses made necessary thereby, shall be at the contractor's expense.

**3.33 REQUEST FOR INFORMATION (RFI) REQUIREMENTS**

- A. All RFI's shall include the following information based on AIA Document G716:
  - 1 To, From, Project Name, Issue Date, RFI number in sequential order with all other trades, Requested Reply Date.
  - 2 Provide a description with specification and/or drawing references.
  - 3 Provide the senders recommendation including cost and/or schedule considerations.
  - 4 Provide receiver's reply space.
  - 5 Note an RFI reply is not an authorization to proceed with the work involving additional cost/time.

**3.34 SHOP DRAWING REQUIREMENTS**

- A. The following is a list of required shop drawings for the project. Not all items may be identified, and it is the responsibility of the contractor to submit additional shop drawings where indicated in the specifications.

<b>PLUMBING</b>	<b>DATE REC'D</b>	<b>ACTION</b>	<b>DATE REC'D</b>	<b>ACTION</b>
COORDINATION DRAWINGS				
VALVES, STRAINERS				
BACKFLOW PREVENTORS				
MIXING VALVES				

<b>PLUMBING</b>	<b>DATE REC'D</b>	<b>ACTION</b>	<b>DATE REC'D</b>	<b>ACTION</b>
PIPING/FITTINGS/LABELING				
DRAINS				
FIXTURES/TRIM/CARRIERS				
INSULATION A. HANDICAP COVERS B. DOMESTIC WATER PIPING C. EQUIPMENT				
WATER HEATERS				
HOT WATER RETURN PUMPS				
AS-BUILT DRAWINGS/CAD DISK				
WARRANTIES AND GUARANTEES				
OPERATIONS AND MAINTENANCE MANUALS				
INSTRUCTIONS				
TESTS/CERTIFICATIONS				
EMERGENCY AND MANUFACTURER CONTACTS				

END OF SECTION

## **SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Sleeves.
  2. Sleeve-seal systems.
  3. Grout.

#### 1.02 ACTION SUBMITTALS

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

### **PART 2 - PRODUCTS**

#### 2.01 SLEEVES

- A. Cast Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

#### 2.02 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
  2. GPT; an EnPro Industries company.
  3. Metraflex Company (The).
  4. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  2. Pressure Plates: Carbon steel.

3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

### 2.03 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.01 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and



make a watertight seal.

### 3.03 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6-inch: Cast-iron wall sleeves.
    - b. Piping NPS 6-inch and Larger: Cast-iron wall sleeves.
  2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6-inch Cast-iron wall sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6-inch and Larger: Cast-iron wall sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6-inch: Cast-iron wall sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6-inch and Larger: Cast-iron wall sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  4. Concrete Slabs above Grade:
    - a. Piping Smaller Than NPS 6-inch: Galvanized-steel-pipe sleeves.
    - b. Piping NPS 6-inch and Larger: Galvanized-steel-pipe sleeves.
  5. Interior Partitions:
    - a. Piping Smaller Than NPS 6-inch: Galvanized-steel-pipe sleeves.
    - b. Piping NPS 6-inch and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

## **SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Escutcheons
  2. Floor plates

#### 1.02 ACTION SUBMITTALS

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

### **PART 2 - PRODUCTS**

#### 2.01 ESCUTCHEONS

- A. One Piece, Cast-Brass Type: With polished, chrome-plated, and rough-brass finish and setscrew fastener.
- B. One Piece, Deep-Pattern Type: Deep-drawn, box shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One Piece, Stamped-Steel Type: With chrome plated finish and spring-clip fasteners.

#### 2.02 FLOOR PLATES

- A. One Piece Floor Plates: Cast-iron flange with holes for fasteners.

### **PART 3 - EXECUTION**

#### 3.01 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One piece, cast-brass type with polished, chrome-

- plated finish.
- c. Insulated Piping: One-piece, stamped-steel type.
- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, stamped-steel type.
- f. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast-brass type with polished, chrome-plated finish.
- g. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, stamped-steel type.
- h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
- j. Bare Piping in Equipment Rooms: One piece, cast-brass type with polished, chrome-plated finish.
- k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping: One piece, floor plate type.

### 3.02 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

## **SECTION 22 05 23.12 - BALL VALVES FOR PLUMBING PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Brass ball valves.
  2. Bronze ball valves.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
1. Certification that products comply with NSF 61 Annex G and NSF 372.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded end valves.
  2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  3. ASME B16.18 for solder-joint connections.
  4. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
  2. Handlever: For quarter-turn valves smaller than NPS 4.
- H. Valves in Insulated Piping:
1. Include 2-inch stem extensions.
  2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.

3. Memory stops that are fully adjustable after insulation is applied.

## 2.02 BRASS BALL VALVES

### A. Brass Ball Valves, One-Piece:

1. Manufacturers:
  - a. KITZ Corporation
  - b. WATTS
  - c. Apollo
  - d. Grove
  - e. Jamesbury
  - f. NIBCO
2. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 400 psig.
  - c. Body Design: One piece.
  - d. Body Material: Forged brass or bronze.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Brass or stainless steel.
  - h. Ball: Chrome-plated brass or stainless steel.
  - i. Port: Reduced.

## 2.03 BRONZE BALL VALVES

### A. Bronze Ball Valves, One-Piece:

1. Manufacturers:
  - a. NIBCO Inc.
  - b. WATSS
  - c. Apollo
2. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 400 psig.
  - c. Body Design: One piece.
  - d. Body Material: Bronze.
  - e. Ends: Threaded.
  - f. Seats: PTFE.
  - g. Stem: Bronze.
  - h. Ball: Chrome-plated brass.

## PART 3 - EXECUTION

### 3.01 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

### 3.02 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

### 3.03 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Brass ball valves, one piece.
  - 3. Bronze ball valve, one piece with bronze trim.

### 3.04 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE 150 TO 200 PSIG

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Brass ball valve, one piece.
  - 3. Bronze ball valve with bronze trim, one piece.

### 3.05 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Brass ball valve, one piece.
  - 3. Bronze ball valve, one piece with bronze trim.

END OF SECTION

## **SECTION 22 05 23.14 - CHECK VALVES FOR PLUMBING PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Bronze swing check valves.
  2. Iron swing check valves.
  3. Iron swing check valves with closure control.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
1. Certification that products comply with NSF 61 Annex G and NSF 372.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded end valves.
  2. ASME B16.1 for flanges on iron valves.
  3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  4. ASME B16.18 for solder joint.
  5. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Bypass and Drain Connections: MSS SP-45.

#### 2.02 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Bronze Disc, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Valve, Inc.

- b. Apollo Valves; Conbraco Industries, Inc.
- c. Crane; Crane Energy Flow Solutions.
- d. Hammond Valve.
- e. Jenkins Valves; Crane Energy Flow Solutions.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. Stockham; Crane Energy Flow Solutions.
- j. Watts; a Watts Water Technologies company.
- 2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded or soldered. See valve schedule articles.
  - f. Disc: Bronze.
- B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Jenkins Valves; Crane Energy Flow Solutions.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Red-White Valve Corporation.
    - g. Stockham; Crane Energy Flow Solutions.
    - h. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 4.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B 62, bronze.
    - e. Ends: Threaded or soldered. See valve schedule articles.
    - f. Disc: PTFE.

### 2.03 IRON SWING CHECK VALVES

- A. Iron Swing Check Valves with Metal Seats, Class 125:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Jenkins Valves; Crane Energy Flow Solutions.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Red-White Valve Corporation.
    - g. Stockham; Crane Energy Flow Solutions.
    - h. Watts; a Watts Water Technologies company.
  - 2. Description:



- a. Standard: MSS SP-71, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Clear or full waterway.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged or threaded. See valve schedule articles.
  - f. Trim: Bronze.
  - g. Gasket: Asbestos free.
- B. Iron Swing Check Valves with Nonmetallic-to-Metal Seats, Class 125:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Stockham; Crane Energy Flow Solutions.
  - 2. Description:
    - a. Standard: MSS SP-71, Type I.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Clear or full waterway.
    - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    - e. Ends: Flanged or threaded. See valve schedule articles.
    - f. Trim: Composition.
    - g. Seat Ring: Bronze.
    - h. Disc Holder: Bronze.
    - i. Disc: PTFE.
    - j. Gasket: Asbestos free.

#### 2.04 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Iron Swing Check Valves with Lever- and Spring-Closure Control, Class 125:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Jenkins Valves; Crane Energy Flow Solutions.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Stockham; Crane Energy Flow Solutions.
    - g. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-71, Type I.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Clear or full waterway.
    - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    - e. Ends: Flanged or threaded. See valve schedule articles.
    - f. Trim: Bronze.
    - g. Gasket: Asbestos free.
    - h. Closure Control: Factory-installed exterior lever and spring.
- B. Iron Swing Check Valves with Lever and Weight-Closure Control, Class 125:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; Conbraco Industries, Inc.

- b. Crane; Crane Energy Flow Solutions.
  - c. Hammond Valve.
  - d. Jenkins Valves; Crane Energy Flow Solutions.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Stockham; Crane Energy Flow Solutions.
  - h. Watts; a Watts Water Technologies company.
2. Description:
- a. Standard: MSS SP-71, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Clear or full waterway.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged or threaded. See valve schedule articles.
  - f. Trim: Bronze.
  - g. Gasket: Asbestos free.
  - h. Closure Control: Factory installed exterior lever and weight.

## PART 3 - EXECUTION

### 3.01 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

### 3.02 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Pump-Discharge Check Valves:
    - a. NPS 2 inch and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
    - b. NPS 2 ½ - inch and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; metal-seat or resilient-seat check valves.
    - c. NPS 2 ½ - inch and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

1. For Copper Tubing, NPS 2-inch and Smaller: Threaded or soldered.
2. For Copper Tubing, NPS 2 ½ -inch to NPS 4-inch: Flanged or threaded.
3. For Copper Tubing, NPS 5-inch and Larger: Flanged.
4. For Steel Piping, NPS 2-inch and Smaller: Threaded.
5. For Steel Piping, NPS 2 ½ -inch to NPS 4-inch: Flanged or threaded.
6. For Steel Piping, NPS 5-inch and Larger: Flanged.

3.04 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 inch and Smaller:

1. Horizontal and Vertical Applications: Bronze swing check valves with bronze nonmetallic disc, Class 125, with soldered or threaded end connections.

B. Pipe NPS 2 ½ - inch and Larger:

1. Iron swing check valves with metal nonmetallic-to-metal seats, Class 125, with threaded or flanged end connections.

3.05 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG)

A. Pipe NPS-2-inch and Smaller:

1. Horizontal and Vertical Applications: Bronze swing check valves bronze nonmetallic disc, Class 125, with soldered or threaded end connections.

B. Pipe NPS 2 ½ - inch and Larger:

1. Iron swing check valves with metal nonmetallic-to-metal seats, Class 125, with threaded or flanged end connections.

3.06 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-inch and Smaller: Bronze swing check valves bronze nonmetallic disc, Class 125, with soldered or threaded end connections.

B. Pipe NPS 2 ½ - inch and Larger:

1. Iron swing check valves with metal nonmetallic-to-metal seats, Class 125, with threaded or flanged end connections.

END OF SECTION

## **SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
1. Metal pipe hangers and supports.
  2. Trapeze pipe hangers.
  3. Thermal-hanger shield inserts.
  4. Fastener systems.
  5. Pipe positioning systems.
  6. Equipment supports.

#### **1.02 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
  2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

#### **1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
  2. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### **1.04 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

## 1.05 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.01 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

### 2.02 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.03 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100- or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

#### 2.04 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

#### 2.05 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

#### 2.06 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

#### 2.07 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

### **PART 3 - EXECUTION**

#### 3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
  1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2-inch and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
  1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4-inch and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4-inch and larger if pipe is installed on rollers.
  4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4-inch to NPS 3 ½ -inch: 12 inches long and 0.048 inch thick.
    - b. NPS 4-inch: 12 inch long and 0.06 inch thick.

- c. NPS 5-inch and NPS 6-inch: 18 inches long and 0.06 inch thick.
- d. NPS 8-inch to NPS 14-inch: 24 inches long and 0.075 inch thick.
- e. NPS 16-inch to NPS 24-inch: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8-inch and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.02 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.03 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.04 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1 ½ - inch.

### 3.05 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 a minimum dry film thickness of 2.0 mils.
- B. galvanizing-repair paint to comply with ASTM A 780.

### 3.06 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and



- equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
  - C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
  - D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
  - E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
  - F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
  - G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
  - H. Use padded hangers for piping that is subject to scratching.
  - I. Use thermal-hanger shield inserts for insulated piping and tubing.
  - J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
    1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2-inch to NPS 30-inch.
    2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg. F, pipes NPS 4-inch to NPS 24-inch, requiring up to 4 inches of insulation.
    3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4-inch to NPS 36-inch, requiring clamp flexibility and up to 4 inches of insulation.
    4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2-inch to NPS 8-inch.
    5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2-inch to NPS 30-inch.
    6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4-inch to NPS 36-inch, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
    7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4-inch to NPS 36-inch, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
    8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1-inch to NPS 30-inch, from two rods if longitudinal movement caused by expansion and contraction might occur.
    9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2-inch to NPS 42-inch if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  - K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
    1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
    2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
  - L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg. F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1 ¼ inches.
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

## SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
1. Equipment labels.
  2. Warning signs and labels.
  3. Pipe labels.

#### 1.02 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. Manufacturers:
    - a. Brady Corporation
    - b. Brimar Industries, Inc.
    - c. Craftmark Pipe Makers
    - d. Marking Services, Inc.
    - e. Seton Identification Products
  2. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  3. Letter Color: Black.
  4. Background Color: Yellow.
  5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  7. Fasteners: Stainless-steel rivets or self-tapping screws.
  8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:

1. Manufacturers:
    - a. Brady Corporation
    - b. Brimar Industries, Inc.
    - c. Craftmark Pipe Markers
    - d. Marking Services, Inc.
    - e. Seton Identification Products
  2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
  3. Letter Color: Black.
  4. Background Color: Yellow.
  5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  8. Fasteners: Stainless-steel rivets or self-tapping screws.
  9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.02 WARNING SIGNS AND LABELS

- A. Manufacturers:
1. Brady Corporation
  2. Brimar Industries, Inc.
  3. Craftmark Pipe Makers
  4. Marking Services Inc.
  5. National Marker Company
  6. Seton Identification Products
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater

viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.03 PIPE LABELS

- A. Manufacturers:
  - 1. Brady Corporation
  - 2. Brimar Industries, Inc.
  - 3. Craftmark Pipe Makers
  - 4. Marking Services Inc.
  - 5. Seton Identification Products
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: Size letters according to ASME A13.1 for piping At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

## PART 3 - EXECUTION

### 3.01 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.02 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings unfinished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
1. Low-Pressure Compressed Air Piping:
    - a. Background: Safety blue.
    - b. Letter Colors: White.
  2. High-Pressure Compressed Air Piping:
    - a. Background: Safety blue.
    - b. Letter Colors: White.
  3. Domestic Water Piping
    - a. Background: Safety green.
    - b. Letter Colors: White.
  4. Sanitary Waste and Storm Drainage Piping:
    - a. Background Color: Yellow
    - b. Letter Color: Black.

END OF SECTION

## **SECTION 22 07 19 - PLUMBING PIPING INSULATION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic hot-water piping.
  - 2. Domestic recirculating hot water piping.
  - 3. Roof drains and rainwater leaders.
  - 4. Supplies and drains for handicap-accessible lavatories and sinks.

#### **1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.

#### **1.03 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

#### **1.04 QUALITY ASSURANCE**

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

## PART 2 - PRODUCTS

### 2.01 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Pittsburgh Corning Corporation.
  - 2. Special-Shaped Insulation: ASTM C 552, Type III.
  - 3. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
  - 4. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
  - 5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge or expanded rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. K-Flex USA.
- H. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Manson Insulation Inc.
    - d. Owens Corning.
  - 2. Type I, 850 Deg. F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of



the following:

- a. Armacell LLC.
- b. Nomaco Insulation.

## 2.02 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Ramco Insulation, Inc.

## 2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg. F.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Foster Brand; H. B. Fuller Construction Products.
    2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    3. Adhesive 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."
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. K-Flex USA.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
- E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Dow Corning Corporation.
  - b. Johns Manville; a Berkshire Hathaway company.
  - c. P.I.C. Plastics, Inc.
  - d. Speedline Corporation.

#### 2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Foster Brand; H. B. Fuller Construction Products.
    - b. Knauf Insulation.
    - c. Vimasco Corporation.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg. F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Knauf Insulation.
    - e. Mon-Eco Industries, Inc.
    - f. Vimasco Corporation.
  2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg. F.
  4. Solids Content: 60 percent by volume and 66 percent by weight.
  5. Color: White.

#### 2.05 SEALANTS

- A. Joint Sealants for Cellular-Glass Products:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
    - e. Pittsburgh Corning Corporation.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Permanently flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 100 to plus 300 deg. F.
  5. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg. F.
  5. Color: Aluminum.
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg. F.
  5. Color: White.

## 2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.07 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Foster Brand; H. B. Fuller Construction Products.
    - b. Vimasco Corporation.

## 2.08 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming.

Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. P.I.C. Plastics, Inc.
    - c. Proto Corporation.
    - d. Speedline Corporation.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White or Color-code jackets based on system. Color as selected by Architect.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45 and 90-degree, short and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. ITW Insulation Systems; Illinois Tool Works, Inc.
    - c. RPR Products, Inc.
  2. Sheet and roll stock ready for shop or field sizing.
  3. Finish and thickness are indicated in field-applied jacket schedules.
  4. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
  5. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
  6. Factory-Fabricated Fitting Covers:
    - a. Same material, finish, and thickness as jacket.
    - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - c. Tee covers.
    - d. Flange and union covers.
    - e. End caps.
    - f. Beveled collars.
    - g. Valve covers.
    - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Pittsburgh Corning Corporation.
    - b. Polyguard Products, Inc.

## 2.09 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive,

complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Compac Corporation.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
    - e. Venture Tape.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces' force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Compac Corporation.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
    - e. Venture Tape.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces' force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lb./inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Compac Corporation.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.
    - c. Venture Tape.
  2. Width: 2 inches.
  3. Thickness: 6 mils.
  4. Adhesion: 64 ounces' force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Compac Corporation.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.

- e. Venture Tape.
- 2. Width: 2 inches.
- 3. Thickness: 3.7 mils.
- 4. Adhesion: 100 ounces' force/inch in width.
- 5. Elongation: 5 percent.
- 6. Tensile Strength: 34 lbf/inch in width.

## 2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ITW Insulation Systems; Illinois Tool Works, Inc.
    - b. RPR Products, Inc.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. C & F Wire.

## 2.11 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Engineered Brass Company.
    - b. Insul-Tect Products Co.
    - c. McGuire Manufacturing.
    - d. Plumberex Specialty Products, Inc.
    - e. Truebro.
    - f. Zurn Industries, LLC.
  - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Truebro.
    - b. Zurn Industries, LLC.
  - 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### **3.02 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1 ½ - inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Cleanouts.

### 3.03 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation



continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.04 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers

- to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.05 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation

- of same thickness as pipe insulation.
- 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  - 2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed sections of cellular glass insulation to valve body.
  - 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 3. Install insulation to flanges as specified for flange insulation application.

### 3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  - 1. Install pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install mitered sections of pipe insulation.
  - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 3. Install insulation to flanges as specified for flange insulation application.
  - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.07 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
  - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten

- bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  4. Install insulation to flanges as specified for flange insulation application.

### 3.08 INSTALLATION OF POLYOLEFIN INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install mitered sections of polyolefin pipe insulation.
  - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
  - 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 3. Install insulation to flanges as specified for flange insulation application.
  - 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.09 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1 ½ -inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.10 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water: Insulation shall be one of the following:

	Temp	Up to 1"	Up to 1.5"	Up to 4"	Up to 8"	8" & Up
<b>1. Hot Water</b>						
a) Domestic HW/HWR	100-130	1"	1"	1.5"	1.5"	1.5"

- B. Domestic Cold Water
  - 1. Flexible Elastomeric: 1 inch thick.
  - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - 3. Polyolefin: 1 inch thick.
- C. Stormwater and Overflow: Insulation shall be one of the following:
  - 1. Flexible Elastomeric: 1 inch thick.
  - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - 3. Polyolefin: 1 inch thick.
- D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be one of the following:
  - 1. Flexible Elastomeric: 1/2 inch thick.
  - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
  - 3. Polyolefin: 1/2 inch thick.

### 3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  - 1. PVC: 20 mils thick.
  - 2. Aluminum, Smooth 0.016 inch thick.
- D. Piping, Exposed:
  - 1. None.
  - 2. PVC: 20 mils thick.
  - 3. Aluminum, Smooth: 0.016 inch thick.

END OF SECTION

## **SECTION 22 11 16 - DOMESTIC WATER PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Copper tube and fittings.
  - 2. Piping joining materials.
  - 3. Dielectric fittings.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.
- B. Sustainable Design Submittals:

#### 1.03 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

### **PART 2 - PRODUCTS**

#### 2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."
- C. Comply with NSF Standard 372 for low lead.

#### 2.02 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B) water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.



3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

## G. Copper Pressure-Seal-Joint Fittings:

1. Fittings for NPS 2-inch and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
2. Fittings for NPS 2 ½ to NPS 4-inch: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

## 2.03 PIPING JOINING MATERIALS

## A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full face or ring type unless otherwise indicated.

## B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

## C. Solder Filler Metals: ASTM B 32, lead-free alloys.

## D. Flux: ASTM B 813, water flushable.

## E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

## 2.04 DIELECTRIC FITTINGS

## A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

## B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Central Plastics Company.
  - b. Jomar Valve.
  - c. Matco-Norca.
  - d. Watts; a Watts Water Technologies company.
  - e. Wilkins.
  - f. Zurn Industries, LLC.
2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg. F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

## C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Matco-Norca.
  - d. Watts; a Watts Water Technologies company.
  - e. Wilkins.
  - f. Zurn Industries, LLC.
2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.

4. Pressure Rating: 125 psig minimum at 180 deg. F.
  5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  2. Nonconducting materials for field assembly of companion flanges.
  3. Pressure Rating: 150 psig
  4. Gasket: Neoprene or phenolic.
  5. Bolt Sleeves: Phenolic or polyethylene.
  6. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elster Perfection Corporation.
    - b. Grinnell Mechanical Products.
    - c. Matco-Norca.
    - d. Precision Plumbing Products.
    - e. Victaulic Company.
  2. Standard: IAPMO PS 66.
  3. Electroplated steel nipple complying with ASTM F 1545.
  4. Pressure Rating and Temperature: 300 psig at 225 deg. F.
  5. End Connections: Male threaded or grooved.
  6. Lining: Inert and noncorrosive, propylene.

### **PART 3 - EXECUTION**

#### **3.01 EARTHWORK**

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

#### **3.02 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Install domestic water piping level with 0.25 percent slope downward toward drain and

- plumb.
- E. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
  - F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
  - G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
  - H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
  - I. Install piping to permit valve servicing.
  - J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
  - K. Install piping free of sags and bends.
  - L. Install fittings for changes in direction and branch connections.
  - M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
  - N. Install thermometers on inlet and outlet piping from each water heater.
  - O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
  - P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
  - Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.03 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  1. Apply appropriate tape or thread compound to external pipe threads.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

- H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

#### 3.04 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1 ½ -inch and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2-inch and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 inch and Smaller: Plastic-to-metal transition fittings or unions.

#### 3.05 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2-inch and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2 ½ -inch to NPS 4-inch: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5-inch and Larger: Use dielectric flange kits.

#### 3.06 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 -inch and Smaller: 60 inches with 3/8-inch rod.
  - 2. NPS 1-inch and NPS 1 ¼ -inch: 72 inches with 3/8-inch rod.
  - 3. NPS 1 ½ -inch and NPS 2-inch: 96 inches with 3/8-inch rod.
  - 4. NPS 2 ½ -inch: 108 inches with 1/2-inch rod.
  - 5. NPS 3 to NPS 5-inch: 10 feet with 1/2-inch rod.
  - 6. NPS 6-inch: 10 feet with 5/8-inch rod.
  - 7. NPS 8-inch: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1 ¼ -inch and Smaller: 84 inches with 3/8-inch rod.

2. NPS 1/1/2 -inch: 108 inches with 3/8-inch rod.
  3. NPS 2-inch: 10 feet with 3/8-inch rod.
  4. NPS 2 ½ -inch: 11 feet with 1/2-inch rod.
  5. NPS 3-inch and NPS 3 ½ inch: 12 feet with 1/2-inch rod.
  6. NPS 4-inch and NPS 5-inch: 12 feet with 5/8-inch rod.
  7. NPS 6-inch: 12 feet with 3/4-inch rod.
  8. NPS 8-inch to NPS 12-inch: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

### 3.07 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

### 3.08 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

### 3.09 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. Piping Inspections:
    - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
    - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections, and arrange for reinspection.
    - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
  2. Piping Tests:
    - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
  - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.10 ADJUSTING

- A. Perform the following adjustments before operation:
- 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Open throttling valves to proper setting.
  - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

- d. Repeat procedures if biological examination shows contamination.
- e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3-inch and smaller, shall be one of the following:
  - 1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A) ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper, solder-joint fittings; and brazed copper pressure-seal fittings; and pressure-sealed joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4-inch to NPS 8-inch and larger, shall be one of the following:
  - 1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A) ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper, solder-joint fittings; and brazed joints.
  - 2. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6-inch to NPS 12-inch, shall be one of the following:
  - 1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- G. Under-building-slab, domestic water piping, NPS 2-inch and smaller shall be one of the following:
  - 1. Hard or soft copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper, solder-joint fittings; and brazed copper pressure-seal-joint fittings; and pressure-sealed joints.
- H. Aboveground domestic water piping, NPS 2-inch and smaller shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast or wrought-copper, solder-joint fittings; and soldered joints.
  - 2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.
  - 3. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper push-on-joint fittings; and push-on joints.
- I. Aboveground domestic water piping, NPS 2 ½ - to NPS 4-inch shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast or wrought copper, solder-joint fittings; and soldered joints.
  - 2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.
  - 3. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); grooved-joint, copper-tube appurtenances; and grooved joints.
  - 4. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and

- threaded joints.
- J. Aboveground domestic water piping, NPS 5-inch to NPS 8-inch, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast or wrought-copper, solder-joint fittings; and soldered joints.
  2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B)); grooved-joint, copper-tube appurtenances; and grooved joints.
  3. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
- K. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6-inch to NPS 12-inch, shall be one of the following:
1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
  2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.

END OF SECTION



## **SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Vacuum breakers.
  2. Backflow preventers.
  3. Water pressure-reducing valves.
  4. Balancing valves.
  5. Strainers.
  6. Drain valves.
  7. Water-hammer arresters.
  8. Trap-seal primer valves.

#### 1.02 ACTION SUBMITTALS

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

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.04 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 Annex G.

#### 2.02 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

#### 2.03 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers
1. Standard: ASSE 1001.

2. Size: NPS 1/4-inch to NPS 3-inch, as required to match connected piping.
  3. Body: Bronze.
  4. Inlet and Outlet Connections: Threaded.
  5. Finish: Rough bronze or Chrome plated.
- B. Hose-Connection Vacuum Breakers
1. Standard: ASSE 1011.
  2. Body: Bronze, nonremovable, with manual drain.
  3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  4. Finish: Chrome or nickel plated.

## 2.04 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers
1. Standard: ASSE 1012.
  2. Operation: Continuous-pressure applications.
  3. Size: NPS 1/2-inch.
  4. Body: Bronze.
  5. End Connections: Union, solder joint.
  6. Finish: Rough bronze.
- B. Reduced-Pressure-Principle Backflow Preventers
1. Standard: ASSE 1013.
  2. Operation: Continuous-pressure applications.
  3. Pressure Loss: 12 psig maximum, through middle third of flow range.
  4. Body: Bronze for NPS 2-inch and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved NPS 2 ½ -inch and larger.
  5. End Connections: Threaded for NPS 2-inch and smaller; flanged for NPS 2 ½ -inch and larger.
  6. Configuration: Designed for horizontal, straight-through or vertical flow.
  7. Accessories:
    - a. Valves NPS 2-inch and Smaller: Ball type with threaded ends on inlet and outlet.
    - b. Valves NPS 2 ½ -inch and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- C. Double-Check, Backflow-Prevention Assemblies
1. Standard: ASSE 1015.
  2. Operation: Continuous-pressure applications unless otherwise indicated.
  3. Pressure Loss: 5 psig maximum, through middle third of flow range.
  4. Body: Bronze for NPS 2-inch and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2 ½ -inch and larger.
  5. End Connections: Threaded for NPS 2 inch and smaller; flanged for NPS 2 ½ -inch and larger.
  6. Configuration: Designed for horizontal, straight-through flow.
  7. Accessories:
    - a. Valves NPS 2-inch and Smaller: Ball type with threaded ends on inlet and outlet.
    - b. Valves NPS 2 ½ -inch and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

## 2.05 BALANCING VALVES

### A. Memory-Stop Balancing Valves

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; Conbraco Industries, Inc.
  - b. Jenkins Valves; Crane Energy Flow Solutions.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Stockham; Crane Energy Flow Solutions.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2-inch or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

## 2.06 STRAINERS FOR DOMESTIC WATER PIPING

### A. Y-Pattern Strainers

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 inch and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2 ½ - inch and larger.
3. End Connections: Threaded for NPS 2 inch and smaller; flanged for NPS 2 ½ - inch and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
  - a. Strainers NPS 2-inch and Smaller: 0.020 inch.
  - b. Strainers NPS 2 ½ -inch to NPS 4-inch: 0.045 inch.
  - c. Strainers NPS 5-inch and Larger: 0.10 inch.
6. Drain: Pipe plug.

## 2.07 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4-inch.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.

9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.08 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg. Co.
  - b. Josam Company.
  - c. Precision Plumbing Products.
  - d. Sioux Chief Manufacturing Company, Inc.
  - e. Watts; a Watts Water Technologies company.
  - f. Zurn Industries, LLC.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.09 TRAP-SEAL PRIMER DEVICE

### A. Supply-Type, Trap-Seal Primer Device

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg. Co.
  - b. Precision Plumbing Products.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Watts; a Watts Water Technologies company.
  - e. Zurn Industries, LLC.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1-inch threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2-inch threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

### B. Drainage-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Jay R. Smith Mfg. Co.
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8-inch minimum, trap makeup connection.
3. Size: NPS 1 ¼ -inch minimum.
4. Material: Chrome-plated, cast brass.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air brakes are unacceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve and pump.
- D. Install water-hammer arresters in water piping according to PDI-WH 201.
- E. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- F. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

#### **3.02 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

#### **3.03 ADJUSTING**

- A. Set field-adjustable flow set points of balancing valves.

END OF SECTION

## **SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Pipe, tube, and fittings.
  - 2. Specialty pipe fittings.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
- B. Field quality-control reports.

### **PART 2 - PRODUCTS**

#### 2.01 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

#### 2.02 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

#### 2.03 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

#### 2.04 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Copper Pressure Fittings:
  - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- D. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
  - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

## 2.05 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 2. Unshielded, Nonpressure Transition Couplings:
    - a. Manufacturers:
      - 1) Fernco Inc
      - 2) Froet Industries LLC
      - 3) Plastic Oddities
    - b. Standard: ASTM C 1173.
    - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - d. End Connections: Same size as and compatible with pipes to be joined.
    - e. Sleeve Materials:
      - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
  - 3. Shielded, Nonpressure Transition Couplings:
    - a. Manufacturers:
      - 1) Cascade Waterworks Mfg.
      - 2) Mission Rubber Co.
    - b. Standard: ASTM C 1460.
    - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - d. End Connections: Same size as and compatible with pipes to be joined.

## PART 3 - EXECUTION

### 3.01 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

### 3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drainpipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."



- N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- O. Plumbing Specialties:
  - 1. Install backwater valves in sanitary waster gravity-flow piping.
    - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 3. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.03 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipes and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

### 3.04 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in ODs.
  - 2. In Waste Drainage Piping: Unshielded nonpressure transition couplings.

### 3.05 VALVE INSTALLATION

- A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.
- B. Shutoff Valves:
  - 1. Install shutoff valve on each sewage pump discharge.

2. Install gate or full-port ball valve for piping NPS 2 and smaller.
  3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

### 3.06 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment." Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  2. Install stainless-steel fiberglass pipe hangers for horizontal piping in corrosive environments.
  3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  2. NPS 3: 60 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
  5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
  6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 84 inches with 3/8-inch rod.
  2. NPS 1-1/2: 108 inches with 3/8-inch rod.
  3. NPS 2: 10 feet with 3/8-inch rod.
  4. NPS 2-1/2: 11 feet with 1/2-inch rod.
  5. NPS 3: 12 feet with 1/2-inch rod.
  6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
  7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
  8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.

- H. Install supports for vertical steel piping every 15 feet.
- I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 2: 84 inches with 3/8-inch rod.
  - 2. NPS 3: 96 inches with 1/2-inch rod.
  - 3. NPS 4: 108 inches with 1/2-inch rod.
  - 4. NPS 6: 10 feet with 5/8-inch rod.
- J. Install supports for vertical stainless-steel piping every 10 feet.
- K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
  - 5. NPS 6: 10 feet with 5/8-inch rod.
  - 6. NPS 8: 10 feet with 3/4-inch rod.
- L. Install supports for vertical copper tubing every 10 feet.
- M. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

### 3.07 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
  - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 5. Equipment: Connect waste piping as indicated.
    - a. Provide shutoff valve if indicated and union for each connection.
    - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.08 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.

- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.09 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections, and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    - d. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.

### 3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
  - 3. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
    - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M (Type C); copper pressure fittings; and soldered joints.
  - 3. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 and larger shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
  - 1. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
  - 1. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION

## **SECTION 22 13 19.13 - SANITARY DRAINS**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Floor drains.
  - 2. Trench drains.

#### 1.02 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. HDPE: High-density polyethylene.
- C. PE: Polyethylene.
- D. PP: Polypropylene.
- E. PVC: Polyvinyl chloride.

#### 1.03 ACTION SUBMITTALS

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

### **PART 2 - PRODUCTS**

#### 2.01 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

#### 2.02 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
  - 1. Manufacturers:
    - a. Jay R Smith Mfg. Co.
    - b. Josam Co.
    - c. MIFAB, Inc
    - d. Sioux Chief Manufacturing
    - e. Wade
    - f. WATTS
    - g. Zurn Industries, LLC
  - 2. Standard: ASME A112.6.3.
  - 3. Pattern: Area Floor, Funnel floor drain.

4. Body Material: Gray iron.
5. Outlet: Bottom Side.
6. Top or Strainer Material: Bronze.
7. Top of Body and Strainer Finish: Nickel bronze.
8. Top Shape: Round Square.
9. Trap Material: Bronze.
10. Trap Pattern: Standard P-trap.
11. Trap Features: Cleanout.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  1. Position floor drains for easy access and maintenance.
  2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
  3. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
  4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
    - a. Maintain integrity of waterproof membranes where penetrated.
  5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- B. Install trench drains at low points of surface areas to be drained.
- C. Install open drain fittings with top of hub 1 inch (25 mm) above floor.

### **3.02 CONNECTIONS**

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- C. Install piping adjacent to equipment to allow service and maintenance.

### **3.03 LABELING AND IDENTIFYING**

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for

Plumbing Piping and Equipment."

### 3.04 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION



## **SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Cleanouts.
  - 2. Miscellaneous sanitary drainage piping specialties.

#### 1.02 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene.
- B. PVC: Polyvinyl chloride.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.04 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### **PART 2 - PRODUCTS**

#### 2.01 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

#### 2.02 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:
  - 1. Manufactures:
    - a. Jay R. Smith Mfg. Co.
    - b. Josam Co.
    - c. MIFAB, Inc
    - d. Tyler Pipe
    - e. WATTS
    - f. Zurn Industries, LLC

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
  3. Size: Same as connected drainage piping
  4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
  5. Closure: Countersunk or raised head, brass, or cast-iron plug.
  6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
  7. Closure: Stainless-steel plug with seal.
- B. Cast-Iron Exposed Floor Cleanouts:
1. Manufacturers:
    - a. Jay R. Smith Mfg.; Co.
    - b. Josam Co.
    - c. MIFAB, Inc
    - d. Sioux Chief Manufacturing
    - e. Zurn Industries, LLC
  2. Standard: ASME A112.36.2M for adjustable housing cleanout.
  3. Size: Same as connected branch.
  4. Type: Adjustable housing.
  5. Body or Ferrule: Cast iron.
  6. Clamping Device: Not required.
  7. Outlet Connection: Inside calk.
  8. Closure: Brass plug with straight threads and gasket.
  9. Adjustable Housing Material: Cast iron with threads setscrews or other device.
  10. Frame and Cover Shape: Round.
  11. Top Loading Classification: Extra Heavy Duty.
  12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to clean out.
- C. Cast-Iron Wall Cleanouts
1. Manufacturers:
    - a. Jay R. Smith Mfg.; Co.
    - b. Josam Co.
    - c. MIFAB, Inc
    - d. Sioux Chief Manufacturing
    - e. Zurn Industries, LLC
  2. Standard: ASME A112.36.2M. Include wall access.
  3. Size: Same as connected drainage piping.
  4. Body: Hub-and-spigot, cast-iron soil pipe T-branch Hubless, cast-iron soil pipe test tee as required to match connected piping.
  5. Closure Plug:
    - a. Brass or Cast iron.
    - b. Countersunk or raised head.
    - c. Drilled and threaded for cover attachment screw.
    - d. Size: Same as or not more than one size smaller than cleanout size.

## 2.03 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where

- required, increaser fitting joined with ASTM C 564 rubber gaskets.
2. Size: Same as connected waste piping.
- B. Deep-Seal Traps:
1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
  2. Size: Same as connected waste piping.
    - a. NPS 2: 4-inch- minimum water seal.
    - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- C. Floor-Drain, Trap-Seal Primer Fittings:
1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
  2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- D. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
  2. Body: Bronze or cast iron.
  3. Inlet: Opening in top of body.
  4. Outlet: Larger than inlet.
  5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- E. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
  2. Size: As required for close fit to riser or stack piping.
- F. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
  2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
  2. Size: Same as connected stack vent or vent stack.
- H. Expansion Joints:
1. Standard: ASME A112.6.4.
  2. Body: Cast iron with bronze sleeve, packing, and gland.
  3. End Connections: Matching connected piping.
  4. Size: Same as connected soil, waste, or vent piping.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install cleanouts in aboveground piping and building drain piping according to the following,

unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Assemble open drain fittings and install with top of hub 2 inches above floor.
- E. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- F. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  2. Size: Same as floor drain inlet.
- G. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- H. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- I. Install vent caps on each vent pipe passing through roof.
- J. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- K. Install wood-blocking reinforcement for wall-mounting-type specialties.
- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### 3.02 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

### 3.03 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.

- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

#### 3.04 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
  - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

#### 3.05 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

## **SECTION 22 40 00 - PLUMBING FIXTURES AND EQUIPMENT**

### **PART 1 - GENERAL**

#### 1.01 REFERENCE

- A. Refer to Section 22 05 00 for requirements which are applicable to this section.
- B. Reference the requirements of the National Standard Plumbing Code.
- C. Where the contract documents are more stringent but not in conflict with the applicable codes, the more stringent requirements shall be followed.

#### 1.02 WORK INCLUDED

- A. Furnish and install plumbing fixtures, drains, trim, supplies, fastening devices, carriers, valves, and traps for a complete installation.
- B. Provide connection of all services for soil, waste, vent, cold and hot water.

#### 1.03 SUBMITTALS

- A. Submit shop drawings of all materials and products described in this section and indicated on the drawings including that listed in the schedule on the drawings.
- B. Fixture submittals shall include all trim associated with the china. They shall be incorporated in a single brochure with the items being furnished clearly identified.

#### 1.04 QUALITY ASSURANCE

- A. All fixtures shall be unmarked, uncracked, true, and level. All shall be warranted to not craze, color, or scale.
- B. Installations shall conform to the National Standard Plumbing Code.
- C. Install all materials and equipment in accordance with the manufacturer's instructions and within the warranty requirements.
- D. All handicapped fixtures and their installation shall conform to the Americans with Disabilities Act and Fair Housing Amendments Act (Public Law 101-336).

### **PART 2 - PRODUCTS**

#### 2.01 TRAPS

- A. Fixture traps shall be approved self-cleaning type with clean-outs.
- B. Traps shall be chrome plated cast brass.
- C. Traps for lavatories shall be 1 1/4" x 1 1/2" size.

## 2.02 TRIM

- A. All trim including faucets, waste fittings, strainers, valves, supplies, nipples, and escutcheons shall be chrome plated cast brass.
- B. Exposed water supply pipes shall be chrome plated brass with loose key angle stops.
- C. Fixtures shall be selected for low water consumption and limited to 1.6 gallons per flush on toilets, 2.2 gpm for faucets, and 2.5 gpm for showers.
- D. Public toilet room faucets shall be self-closing metering type when not indicated for the handicapped. Handicapped faucets shall conform to ADA requirements. Provide an approved temperature limiting device that conforms to ASSE 1070.
- E. All lavatories in public toilet rooms shall have grid type strainers.
- F. Waste connections for handicapped lavatories shall be offset. Contractor is to insulate all exposed domestic water and waste piping with prefab PVC jacketed assemblies.
- G. For fixtures requiring flush valves, they shall be of the low consumption type. Selection shall be for use with the specified fixture.
- H. 'Eco-drive' sensor operated flush valves and faucets shall include regenerating battery system.
- I. Water cooler shall have a bottle filler on the low station.

## 2.03 CARRIERS

- A. All wall hung fixtures shall be provided with floor mounted carriers.
- B. Floor mounted carriers shall have short pattern foot supports.
- C. Carriers for lavatories shall be concealed arm type.

## 2.04 MANUFACTURERS

- A. Fixtures; Kohler, American-Standard, Crane.
- B. Seats; Church, Olsonite, Sperzel, Benke, Bemis.
- C. Carriers; Josam, Zurn, Wade, J.R. Smith, Watts.
- D. Faucets; American-Standard, Speakman, Chicago, Kohler, Delta, Moen.
- E. Supplies and Traps; McGuire, Brass Craft, Central Brass, Kohler, American-Standard.
- F. Shower, Mop Receptors and Laundry Trays; Crane/Fiat, Stern/Williams.
- G. Domestic Water Heaters-Gas; Rheem/Rudd, A.O. Smith, Lochinvar, Jackson, State.
- H. Shower Enclosures - Kohler, American Standard, Crane/Fiat.
- I. Flush Valves - Sloan Royal
- J. Insulation for handicapped lavatory and sink connections insulations - Truebro McGuire "pro-wrap".
- K. Alternate flush valve selection where budget consideration requires a lower cost valve and competitive pricing.

## 2.05 VACUUM BREAKERS

- A. Furnish and install vacuum breakers on all fixtures, trim, or faucets arranged for the connection of hoses. Vacuum breaker shall be located on the discharge side of the valve.
- B. Vacuum breakers shall be chrome plated brass where exposed and rough brass where concealed.
- C. Install vacuum breakers on wall hydrants, hose bibbs, janitor sinks and wherever else required by code.

## 2.06 WATER HEATER DRAIN PAN

- A. Pan shall be galvanized steel - 24 gauge with a minimum height of 1 ½”.
- B. Each pan shall have a 3/4" drain to an acceptable point.

## 2.07 HEATER WARRANTIES

- A. Provide extended warranties of 5 years for commercial and 10 years for residential heaters.

## 2.08 CIRCULATORS

- A. Circulating pumps shall be in-line, centrifugal, close coupled with mechanical seals, all bronze construction similar to TACO or Bell and Gossett.
- B. Pump shall be controlled by adjustable, immersion type Aquastat, Honeywell.

## 2.09 WATER CLOSET CARRIER SELECTION.

- A. Carrier fitting configuration shall be suitable for the stack location shown on the drawings. Carriers to permit handicapped mounting of fixtures shall be utilized where required.

## 2.10 WALL HUNG WATER CLOSET SUPPORTS/FITTINGS

- A. Smith No. 0100 series "adjustable" deep rough-in support. Where floor construction is not suitable for deep rough-in, Smith No. 0200 series shallow rough-in type may be used. Where furred wall space is not sufficient for the adjustable series, Smith "compact" No. 0400 series may be used.

## 2.11 WALL HUNG BLOWOUT WATER CLOSET SUPPORTS/FITTINGS

- A. Smith No. 0300 series "adjustable series fixture supports with type No. 2 closet outlet connection. Where furred wall space is not sufficient for the adjustable series, Smith "compact" No. 0400 series or Smith No. 670 thru 680 waste fitting assemble with type No.2 closet outlet connection may be used.

## 2.12 FLOOR MOUNTED FLOOR OUTLET WATER CLOSET CONNECTION

- A. Smith No. 9230 cast bronze closet flange assembly complete with 5/16" bronze bolts, chromium plated nuts and washers and approved gasket.

## 2.13 WALL HUNG BLOWOUT URINALS ON FLOOR MOUNTED SUPPORT

- A. Smith No. 0629, 0630, 0632, or 0633 urinal support with adjustable coupling assembly. Face plate shall be supported by extra heavy cast iron base support which shall be securely bolted to floor construction.

## 2.14 WALL HUNG BLOWOUT AND WASH-OUT URINALS ON FLOOR MOUNTED SUPPORT

- A. Smith No. 0600 series urinal support. Uprights shall be high-strength steel with block bases securely bolted to floor construction.



**2.15 ELECTRIC WATER COOLER WALL SUPPORT**

- A. Smith No. 0830 floor mounted support electric water cooler support. Uprights shall be high strength steel with block bases securely bolted to floor construction.

**2.16 STEEL BACKING PLATE FOR PLUMBING FIXTURES**

- A. Where plumbing fixtures of the arms which support them are specified to be attached to a steel plate in the wall, furnish and install a 1/4" thick by 6" wide steel plate which shall extend at least one stud beyond the first and last fixture mounting points. Fixture or supporting arms shall be securely and firmly attached to the steel plate in accordance with the manufacturer's instructions.

**2.17 FLAT-SLAB LAVATORIES-CONCEALED ARMS ON BACKING PLATE**

- A. Lavatories shall be punched for Smith No. 0728 concealed arm fixture support with chromium plated threaded escutcheons. The arms shall be securely bolted to steel backing plate in the wall as herein before specified. They shall have positive mechanical locking device and shall be fully adjustable after installation of the finished wall.

**2.18 FLAT-SLAB LAVATORIES-CONCEALED ARMS ON FLOOR SUPPORT**

- A. Lavatories shall be punched for Smith No. 0700-E fixture support. Fixture support shall have chromium plated threaded escutcheons and concealed arms with positive mechanical locking device. Arms shall be fully adjustable after installation of finished wall. Uprights shall be high-strength steel with block bases securely bolted to floor construction.

**PART 3 - EXECUTION****3.01 INSTALLATIONS**

- A. Plumbing fixtures shall be installed in a manner to afford easy access for cleaning. Where practical, all piping from fixtures shall run in the most direct route to the wall.
- B. Furnish and install all waste connections, traps, water supplies, final connections, etc., to equipment furnished under other portions of the specifications.
- C. Make final connections to all soil, waste, vent, and water piping to the fixtures.
- D. Fixtures shall be set level and in proper alignment with adjacent walls and fixtures.
- E. All wall hung fixture carriers to be securely anchored to the slab.
- F. Attach floor mounted water closets to floor with wax seal and lag screws. Do not use lead flashing to hold closet in place.
- G. Securely bolt all fixtures to the building construction and unless special hangers are indicated, provide hangers and/or carriers designed specifically for the fixtures by the fixture manufacture.
- H. Caulk all wall hung fixtures between fixture and wall with sealant specified in Section 07900. Provide sealant at all points where mop receptor meets walls and floor.
- I. Install electric water coolers with "P" trap and water shutoff valve within cabinet.
- J. Contractor shall insulate all exposed domestic water and drainage piping under all handicapped

lavatories and sinks with pre-formed insulation kit with PVC jacket similar to, Lav-Guard as manufactured by Truebro. There shall be no sharp or abrasive surfaces under the handicapped lavatories.

- K. Contractor shall provide an offset tailpiece for the handicapped lavatory's drain piping to create space for wheelchair access.

### 3.02 MOUNTING HEIGHTS

- A. Mount fixtures with the following heights above finished floor, except where noted otherwise.

Water Closet:

Standard	15 inches to top of bowl rim
Handicapped	17 - 19 inches to top of seat

Urinal:

Standard	22 inches to top of bowl rim
Handicapped	17 inches to top of bowl rim

Lavatory:

Standard	31 inches to top of basin rim
Handicapped	34 inches to top of basin rim or 29 inches to underside of basin apron

Drinking Fountain:

Standard	40 inches to top of basin rim
Handicapped	36 inches to bubbler outlet

Water Closet Flush Valves:

Standard	11 inches minimum above bowl rim
Handicapped	Center line of flush valve shall not exceed 44" above fin. fl. Flush valve handle shall extend toward the wide side of stall.

Water Closet Tank Type - Trip Lever

Standard	Per manufacturer
Handicapped	Locate on tank side toward wide side of stall.

END OF SECTION

## **SECTION 23 01 30.52 - EXISTING HVAC AIR DISTRIBUTION SYSTEM CLEANING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section includes cleaning existing HVAC air-distribution equipment, ducts, plenums, and system components.

#### **1.02 DEFINITIONS**

- A. ACAC: American Council for Accredited Certification.
- B. AIHA-LAP: American Industrial Hygiene Association Lab Accreditation Program
- C. ASCS: Air systems cleaning specialist.
- D. CESB: Council of Engineering and Scientific Specialty Boards.
- E. CMI: Certified Microbial Investigator.
- F. CMC: Certified Microbial Consultant.
- G. CMR: Certified Microbial Remediator.
- H. CMRS: Certified Microbial Remediation Supervisor.
- I. EMLAP: Environmental Microbiology Laboratory Accreditation Program.
- J. IEP: Indoor Environmental Professional.
- K. IICRC: Institute of Inspection, Cleaning, and Restoration Certification.
- L. NADCA: National Air Duct Cleaners Association.

#### **1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
  - 1. Product Data: For adhesives and sealants, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.

#### **1.04 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

#### **1.05 QUALITY ASSURANCE**

- A. ASCS Qualifications: A certified member of NADCA
  - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis
  - 2. Supervisor Qualifications: Certified as an ASCS by NADCA
- B. IEP Qualifications: CMI who is certified by ACAC and accredited by CESB.
- C. IEP Qualifications: CMC who is certified by ACAC and accredited by CESB.
- D. CMR Qualifications: Certified by ACAC and accredited by CESB.

- E. CMRS Qualifications: Certified by ACAC and accredited by CESB.

## **PART 2 - PRODUCTS**

### **2.01 HVAC CLEANING AGENTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Apex Engineering Products Corporation.
  2. BBJ Environmental Solutions.
  3. Goodway Technologies Corporation.
  4. Nu-Calgon.
  5. QuestVapco Corporation.
- B. Description:
1. Formulated for each specific soiled coil condition that needs remedy.

### **2.02 ANTIMICROBIAL SURFACE TREATMENT**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bio-Cide International, Inc.
  2. Contec, Inc.
  3. Ecolab, Inc.
- B. Description: Specific product selected shall be as recommended by the IEP based on the specific antimicrobial needs of the specific Project conditions.
1. Formulated to kill and inhibit growth of microorganisms.
  2. EPA-registered for use in HVAC systems and for the specific application in which it will be used.
  3. Have no residual action after drying, with zero VOC off-gassing.
  4. OSHA compliant.
  5. Treatment shall dry clear to allow continued visual observation of the treated surface.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Inspect HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Cleaning Plan: Prepare a written plan for air-distribution system cleaning that includes strategies and step-by-step procedures.

- C. Proceed with work only after conditions detrimental to performance of the Work have been corrected and cleaning plan has been approved.
- D. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- E. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning.

### 3.02 CLEANING

- A. Comply with NADCA ACR.
- B. Perform electrical lockout and tagout according to Owner's standards or authorities having jurisdiction.
- C. Remove non-adhered substances and deposits from within the HVAC system.
- D. Systems and Components to Be Cleaned: All air-moving and -distribution equipment.
- E. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
  - 1. Particulate Collection: For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
  - 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,
- F. Control odors and mist vapors during the cleaning and restoration process.
- G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- I. Clean all air-distribution devices, registers, grilles, and diffusers.
- J. Clean non-adhered substance deposits according to NADCA ACR and the following:
  - 1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
  - 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
  - 3. Clean evaporator coils, reheat coils, and other airstream components.
- K. Air-Distribution Systems:
  - 1. Create service openings in the HVAC system as necessary to accommodate cleaning.
  - 2. Mechanically clean air-distribution systems specified to remove all visible contaminants, so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).
- L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- M. Mechanical Cleaning Methodology:
  - 1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from

within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.

- a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
  - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials, such as duct and plenum liners.
2. Cleaning Mineral-Fiber Insulation Components:
- a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR.
  - b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).
  - c. Fibrous materials that become wet shall be discarded and replaced.
- N. Coil Cleaning:
1. See NADCA ACR, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing coil cleaning verification.
  2. Coil drain pans shall be subject to NADCA ACR, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
  3. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
  4. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations.
  5. Rinse thoroughly with clean water to remove any latent residues.
- O. Application of Antimicrobial Treatment:
1. Apply antimicrobial agents and coatings if active fungal growth is determined by the IEP to be at Condition 2 or Condition 3 status according to IICRC S520, as analyzed by a laboratory accredited by AIHA-LAP with an EMLAP certificate and with results interpreted by an IEP. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
  2. Apply antimicrobial treatments and coatings after the system is rendered clean.
  3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
  4. Microbial remediation shall be performed by a qualified CMR and CMRS.

### 3.03 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR, "Verification of HVAC System Cleanliness" Section.

- B. Surface-Cleaning Verification: Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- C. Verification of Coil Cleaning: Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.
- D. Prepare a written cleanliness verification report.

#### 3.04 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in [Section 233113 "Metal Ducts] [Section 233116 "Nonmetal Ducts]."
- C. Reseal fibrous-glass ducts. Comply with requirements in Section 233116 "Nonmetal Ducts."
- D. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."
- E. Replace damaged insulation according to Section 230713 "Duct Insulation."
- F. Ensure that closures do not hinder or alter airflow.
- G. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.
- H. Restore manual volume dampers and air-directional mechanical devices inside the system to their marked position on completion of cleaning.

END OF SECTION

## **DIVISION 23 - HVAC**

### **SECTION 23 05 00 - STANDARD CONDITIONS FOR HVAC**

#### **PART 1 - GENERAL**

##### **1.01 REFERENCE**

- A. Requirements established within the portions of this project manual titled Division 1, General Requirements are collectively applicable to the work of this section.
- B. Instructions to Bidders, Special Conditions and addenda as issued are part of this specification.
- C. Mechanical, Plumbing, and HVAC drawings along with all other project drawings and specifications represent the work of this section.
- D. Drawings, Contract, General Conditions and Supplementary Conditions form a part of this section, by reference thereto and shall have the same force and effect as if printed herewith in full. Failure to review these sections shall not relieve the Contractor of his responsibility to fully comply with the terms therein.

##### **1.02 SCOPE**

- A. Provide all labor, material, equipment, and supervision necessary to disconnect and remove the existing HVAC equipment and systems to the extent indicated on the drawings. Including, but not limited to; Air handling units, radiators, hot water supply, and return piping, pumps, baseboard radiation, controls, supports, hangers, and associated insulation, equipment pads, and accessories. Patch and repair openings in walls, floors, and ceilings, for piping and equipment that was removed. Pipe, conduit, ductwork, and wiring shall be cut back behind wall surfaces, above ceilings, and below floor levels so that a patch can be placed over the opening.
- B. Provide labor, material, equipment, and supervision necessary to install complete operating mechanical systems as indicated on the drawings and specified herein, including all work at the site and within the proposed construction areas to accomplish the required work.
- C. It shall be the contractor's responsibility to coordinate his work and the work of his subcontractors to insure that all the work is covered. He shall designate who is responsible for various portions of work which may overlap so that there is complete coverage of all required work. It is the position of the owner and the A/E that all work is the responsibility of the mechanical contractor within this Division of the work.
- D. Contractor shall provide all demolition necessary to remove and replace, repair, install new or modify existing work whether it be walls, floors, ceilings, structure, mechanical or electrical required to install his work. Contractor shall replace all work to leave in a finished condition.
- E. All work shown on the drawings and not expressly mentioned in the specifications and all work specified but not shown on the drawings, but necessary for the proper execution of same shall be performed by the contractor. It is not the intent of the drawings and



specifications to describe every feature and detail of the work.

- F. No additions to the contract amount will be approved for any materials, equipment, or labor to perform additional work unless it can be clearly shown to be beyond the scope and intent of the drawings and specifications.
- G. HVAC contractor's scope of work shall include but not be limited to the following:
  - 1. Air distribution system, associated ductwork, devices, equipment, and insulation.
  - 2. Heating hot water system and insulation.
  - 3. Condensate drainage system (air conditioner units). Condensate pumps.
  - 4. Roof penetrations for mechanical work and all associated roof work.
  - 5. Exhaust systems.
  - 6. Demolition of existing work for new work.
  - 7. Test Balance & Adjust.
  - 8. Repair existing areas affected by the new construction. Patch, repair and finish to match existing.
  - 9. Building automation system and automatic temperature controls.
  - 10. All other work identified in Division 23 and/or on the mechanical drawings except that identified as plumbing or fire protection work.
  - 11. Contractor shall not utilize new HVAC equipment for temporary heating, cooling, and dehumidification purposes. Temporary HVAC is to be provided as described under the architect's general conditions. Contractor is to protect all HVAC equipment during construction and cover all ductwork openings.
  - 12. Provide third party certification of all packaged systems by a Nationally Recognized Testing Laboratory (NRTL) in accordance with OSHA Federal Regulations 29CFR1910.303 and .399 as well as Pamphlet #70 and National Electrical Code Article 90-7.
  - 13. Fire stopping of penetrations. (See Section 23 05 50)

#### 1.03 REGULATIONS, CODES, AND STANDARDS

- A. Work shall be performed in accordance with the latest adopted codes, amendments, regulations, and ordinances of the authorities having jurisdiction. Observe all safety regulations including the requirements of OSHA.
- B. Obtain and pay for all permits, connection charges, inspections, and certificates required to complete the work.
- C. Latest editions of any referenced standards shall govern.
- D. Contractor shall arrange and pay for all tests and inspections specified herein or required by above agencies and furnish required certificate of inspection to owner.
- E. Where the contract documents are more stringent but not in conflict with the applicable codes, the more stringent requirements shall be followed.

#### 1.04 SUBMISSIONS

- A. The procedure for submissions of shop drawings shall be as specified in Division 1, or as a minimum, as indicated below.
- B. Furnish submissions of shop drawings and samples of materials and equipment as indicated in these sections, on the drawings, or as directed by the A/E. Submissions will be made in a timely fashion such that adequate time exists to review the drawings, or material, and arrive at the site in accordance with the project schedule.
- C. Submissions will not be accepted with work defined as "By Others". Identify contractor by name and

with his approval so indicated. Submissions are required prior to purchasing, fabrication, or installation of any material or equipment. Submissions shall be reviewed and certified by the submitting contractor that they are in accordance with the project documents.

- D. When requested by the engineer, shop drawings shall be required to be submitted to designated agencies for review and approval prior to submission to the engineer.
- E. Contractor shall arrange and pay for all tests and inspections specified herein or required by above agencies and furnish required certificate of inspection to owner.
- F. Contractor to forward a copy of submittals which have electrical requirements to the Electrical Contractor (EC) for coordination of voltage, amperage, and phase. Response to be received from EC prior to ordering of equipment by mechanical contractor.
- G. Submissions shall include warranties by the manufacturer for equipment being provided. Submissions for commonly related items such as fixtures, trim, carriers, drains shall be combined in a single brochure with all items being furnished clearly identified.
- H. Shop drawings and submittals shall be checked and stamped by the contractor before submitting. They shall conform to measurements made at the site, the contract requirements, and coordinated with all other trades.
- I. Specific models in catalog sheets must be identified as well as all options, voltages, phases, etc. identified so as to be clear on what is being provided.
- J. Contractor and manufacturers shall be responsible for all physical characteristics of the equipment and field verify with final locations, coordinate with floor plans, confirm service access, clearances, confirm equipment arrangements, electrical disconnect clearances, and pathways/travel/access to the final equipment installation locations. Submission of equipment shop drawing will be deemed evidence of compliance with this requirement. If no shop drawing is submitted, contractor shall be fully responsible for a complete installation and assumes all related costs that affects the contractor and other trades.

#### 1.05 SITE INSPECTION

- A. Visit site, inspect, and become aware of all conditions which may affect the work. Investigate utilities, protection requirements for adjacent facilities, storage locations, and access to the construction area.
- B. Submission of bid will be deemed evidence of having complied with this request. Contractor may not request additional costs for existing conditions which were evident from inspection of the site.

#### 1.06 SUBSTITUTIONS

- A. Material and equipment specified shall be deemed as that which the bidder's quotation represents.
- B. Once bids are accepted only that material and equipment listed in the specifications or added by addenda shall be acceptable. Substitution information for inclusion in an addenda must be received by the A/E at least 10 days prior to bid opening. If acceptable, an addenda will be issued which will add the additional acceptable manufacturers or materials and be available for all contractors to consider. It shall be a basic premise that a contractor is a lowest bidder because he utilized substituted materials or equipment as opposed to specified materials or equipment.
- C. If the contractor submits alternate equipment, manufacturers, systems, methods, or materials, not specifically identified in the specifications, additional review and investigation time may be required by the engineer. If the engineer determines additional review time is required because of the substitution, then this will be a billable service by the engineer at the rate of \$150.00/hr. for such services. Also billable will be any redesign time and revisions to drawings should they be necessary.

for incorporation into the work. Services will be billable to the contractor making such substitutions and will be payable prior to approval or rejection.

- D. If the contractor elects to submit alternate equipment, manufacturers, systems, methods, or materials, not specifically identified in the drawings and specifications, it is the contractor's responsibility to coordinate the work with other trades and pay for any associated costs with the substitution or change.
- E. Contractor and manufacturers shall be responsible for all physical characteristics of the equipment and field verify with final locations, coordinate with floor plans, confirm service access, clearances, confirm equipment arrangements, electrical disconnect clearances, and pathways/travel/access to the final equipment installation locations. Submission of equipment shop drawing will be deemed evidence of compliance with this requirement. If no shop drawing is submitted, contractor shall be fully responsible for a complete installation and assumes all related costs that affects the contractor and other trades.

#### 1.07 DRAWINGS AND SPECIFICATIONS

- A. The drawings are generally diagrammatic and necessary field coordination and adjustment must be provided by the contractor prior to installation. Such deviations to the work to allow for coordination shall be kept to a minimum and any such deviations shall be at no extra cost.
- B. When a conflict or contradiction exists either between drawings and specs or between specs or between different drawings or details, the more stringent shall apply.
- C. Drawings and specifications are intended to be taken as a whole and each is to supplement the other. It is not intended that all work must be both shown on drawings and specified in the specifications.
- D. An item shown on the drawings and not indicated in the specifications is to be understood to be required for the project. An item specified and not shown on the drawings is to be understood to be required for the project.
- E. The architects or engineer's interpretation of the documents shall be binding upon the contractor. If a question arises, the contractor shall ask for an interpretation prior to bidding and an answer shall be issued as an addendum to all bidders.
- F. If a question arises after bidding the A/E interpretation shall govern.

#### 1.08 MEASUREMENTS

- A. Before ordering materials or commencing with any work, the contractor shall verify all measurements at the building. Coordination of equipment, materials, spaces, and dimensions are the responsibility of the contractor.

#### 1.09 PROGRESS SCHEDULE

- A. Provide a project schedule which shall show start, sequence of each type of work, milestone schedule, and completion of each type of work, with overall completion date.

#### 1.10 COST SCHEDULE

- A. Provide a detailed cost breakdown indicating labor and material amounts for various types of work.
- B. AIA forms are required for this submission.

#### 1.11 COMPLETION

- A. The contractor shall deliver to the owner, with his request for final payment, copies of all manufacturer's guarantees, equipment instructional manuals, a complete set of all final shop drawings, catalog cuts, service contracts, and other items as may be required elsewhere in the documents.

#### 1.12 OFFICE

- A. The contractor shall set up his job office (desk) where directed by the owner.

#### 1.13 STORAGE

- A. Material shall be stored only where directed by the owner.

#### 1.14 SANITARY

- A. The contractor will at his own expense, provide and maintain in a sanitary condition, a portable chemical toilet.
- B. Toilet will be located where directed by the owner.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL

- A. All material shall be new and of present day manufacturer.
- B. All material and equipment shall be in conformance with accepted trade standards.
- C. Whenever equipment or material is referred to in the singular, such as "the fan", it shall be deemed to apply to as many such items as may be necessary to complete the installation.
- D. The word "provide" means "furnish and install complete, tested, and adjusted as necessary with all accessories, covers, escutcheons". The word "piping" means pipe, fitting, controls, valves, and hangers as required for a complete system.

#### 2.02 MOTORS

- A. Incorporate latest IEEE and NEMA standards.
- B. All copper windings with ball bearings.
- C. Indoors; drip proof, 40 degree C rise.
- D. Outdoors; totally enclosed 55 degree C rise.
- E. Motors over 10 HP to be high efficiency with PF in excess of 0.9.

#### 2.03 MOTOR STARTERS AND CONTACTORS

- A. Fractional with horsepower up to ½ HP; electrical contract.
- B. Polyphase and single phase above ½ HP: this contract.

- C. Electrical contractor shall install all starters except for those provided as an integral part of equipment.
- D. Polyphase starters shall be magnetic combination type, across-the-line electrically operated, electrically held, three pole assemblies, with arc extinguishing characteristics, silver to silver renewable contacts, 3 pole thermal bi-metallic, red run pilot light, individual phase protection, with overload heaters matched to motors installed and with 4 auxiliary contact, Hand-off-Auto switch, and control transformer.
- E. For single phase motors above ½ HP provide magnetic combination single phase motor starters with overloads, non-fusible disconnect switch, red run pilot light, integral 120 volt control transformer with dual primary fusing auxiliary contacts.
- F. Starters shall be as manufactured by G. E., Siemens, Square "D", Cerus or Cutler-Hammer.

#### 2.04 EQUIPMENT START UP

- A. Verify that equipment is operating within warranty requirements.
- B. Advise owner and A/E at least two days prior.
- C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to A/E.

#### 2.05 LUBRICATION

- A. Lubricate all equipment in accordance with manufacturer's instructions.
- B. Lubricate prior to start up.
- C. Provide one year's supply of lubricants to the owner.

#### 2.06 OPERATING INSTRUCTIONS AND MANUALS

- A. Properly and fully instruct owner's personnel in the operation and maintenance of all systems and equipment.
- B. Insure that the owner's personnel are familiar with all operations to carry on required activities.
- C. Such instruction shall be for each item of equipment and each System as a whole.
- D. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, wiring diagrams, control sequences, service requirements, piping diagrams, names, and addresses of vendors, suppliers, and emergency contacts. Three manuals shall be provided.
- E. Provide to the owner any special tools necessary to operate any of the equipment.

#### 2.07 DRAIN PANS

- A. Provide auxiliary galvanized steel condensate drain pan with 1" MPT drain connection for all interior fan coil units, cooling coils, heat pumps, and any other cooling equipment requiring condensate removal. Drain to suitable discharge point acceptable to owner and A/E. Drain lines shall be separate and independent of A/C unit drain system unless provided with interlocked water sensing switch.
- B. All water heaters mounted above the floor shall be provided with drain pans. Drain to suitable discharge point acceptable to owner and A/E. To be visible outfall.
- C. Drains shall slope down in direction of flow at 1" per 10 feet.

### **PART 3 - EXECUTION**

#### **3.01 PROTECTION**

- A. Cover duct openings during construction.
- B. Plug or cap open ends of piping systems and conduit.
- C. Stored materials shall be covered to prevent damage by inclement weather, sun, dust, or moisture.
- D. Protect all installed work until accepted in place by the owner. Cover plumbing fixtures and lighting fixtures.
- E. Do not install plates, polished metal escutcheons, thermostats, and other finished devices until masonry, tile, and painting operations are complete or protect otherwise.
- F. Protect all existing or new work from operations which may cause damage such as hauling, welding, soldering, painting, insulating, and covering.

#### **3.02 WORKMANSHIP**

- A. Install all work neat, trim, and plumb with building lines.
- B. Install work in spaces allocated.
- C. Cutting and patching shall be performed by skilled tradesmen normally employed for the work involved.

#### **3.03 EXCAVATION, SHORING, PUMPING, BACKFILLING**

- A. Perform all excavation required to install the work. Deposit excavated material so as not to create a slide hazard.
- B. No work shall be placed on rock. Cushion with 6 " layer of crushed stone.
- C. Protect tree roots with burlap covering and maintain moist until backfilled.
- D. Base estimates on excavation which will include earth, sand, clay, rubbish, debris, and all other materials up to one cubic yard in size. Boulders or rock larger than one cubic yard which need to be broken up with pneumatic equipment or explosives will be separately negotiated at the time of discovery with the owner and A/E. Do not proceed with rock excavation until an agreement is reached.
- E. Maintain excavations free of water.
- F. Shore excavations to prevent cave-in in accordance with OSHA regulations and to prevent strains on work put in place until ready to receive backfill.
- G. Backfill with clean material and pneumatically tamp in 8" layers. Remove excess material, including rock, from site or as directed by the A/E.
- H. Backfill piping trenches within 18" of footings, columns, piers, or grade beams, with concrete. Protect piping from direct contact and adherence to concrete.
- I. Return to original condition any areas disturbed for excavation.

#### **3.04 FASTENERS, HANGERS, AND SUPPORTS**

- A. Furnish and install all hangers and supports required to suspend, mount, or hang the work.
- B. Furnish and install all miscellaneous steel angles, channels, beams, clips, brackets, and anchors to

hang or support the work. Provide submissions for review.

- C. Install concrete inserts before concrete is poured.
- D. Drilled inserts shall not be loaded to more than 1/4 rated capacity with a minimum of 200 lbs.
- E. Powder driven fasteners shall not be allowed for piping larger than 2", or for equipment. When used they shall not be loaded more than 1/8 rated capacity with a minimum of 200 lbs.
- F. All hangers, miscellaneous steel, braces, and supports shall be galvanized, cadmium plated, or painted with corrosion resistant primer and finish coat of epoxy enamel.
- G. Piping shall be supported from adjustable clevis type hangers with insulation pipe saddles as indicated in the piping system specification sections. Piping shall not support other piping.
- H. Support vertical piping and ductwork at floor levels. Piping shall have split rings. Ductwork shall have 1 1/2" angle iron frames.
- I. Provide and install lintels where required for mechanical work and not indicated on architectural or structural drawings.
- J. Furnish steel framing for roof openings and floor openings. Submit details for review.

### 3.05 SLEEVES

- A. All piping passing through floors or walls shall have sleeves unless holes are cored. Sleeves shall be 16 gage galvanized steel in non-bearing walls, 10 gage galvanized steel for bearing walls, and schedule 40 galvanized pipe in floors. Sleeves shall accommodate insulation. This shall not apply to sprinkler piping.
- B. Sleeves passing through foundation walls not exposed to interior spaces or sleeves passing through slab on grade may be schedule 40 PVC.
- C. Wall sleeves shall finish flush with wall.
- D. Floor sleeves shall extend 1 inch above floor.
- E. Sleeves in walls between interior spaces and unexcavated, exterior, crawl, or backfilled spaces shall be made watertight with "Link-Seal" modular wall and casing seal. Casing shall be schedule 40 galvanized pipe with anchor flange.

### 3.06 PLATES

- A. Furnish and install chrome plated plates wherever piping passes into finished areas.
- B. Plates shall be securely fastened to piping or building construction.
- C. Floor plates shall cover one inch floor extension.

### 3.07 OFFSETS, TRANSITIONS, MODIFICATIONS

- A. Furnish and install all offsets necessary to install the work and to provide clearance for the other trades.
- B. Maintain adequate headroom and clearance as directed by the A/E.
- C. Ductwork transitions necessary to accommodate available space or clearance requirements shall be contract requirements.
- D. Incidental modifications necessary to the installation of the systems shall be made as necessary and at the direction of the A/E.
- E. Rises and drops of piping systems shall be provided as required and where directed to allow for clearances to other construction. Drains shall be installed at no additional cost to the owner. The contractor shall allow for such occurrences in his bid.
- F. Ductwork, piping, conduit, and equipment shall be so arranged as to not pass in front of windows,

doors, access panels, access doors, coil removal or filter removal space or service clearance areas. Do not install within 3'-0" clearance of electrical panel fronts.

### 3.08 RECESSES

- A. Furnish information to the general contractor as to sizes and locations of recesses required to install panels, boxes, grilles, and other equipment or devices which are to be recessed into walls.
- B. Make offsets or modifications as required to suit final locations.

### 3.09 EQUIPMENT SETTING

- A. Furnish and install as a minimum, a 4" thick concrete pad beneath all floor mounted equipment in mechanical rooms, boiler rooms, or equipment rooms, or outside on grade. This shall not apply to residential installations of water heaters and air handling units or furnaces unless detailed on drawings or specified elsewhere.
- B. Furnish and install as a minimum, spring vibration isolators under any equipment 5 HP and over and rubber-in-shear vibration isolation under all equipment less than 5 HP. This shall apply to residential installations.
- C. Reinforce concrete with No. 4 rods 12" on centers both ways.
- D. Pad to have 3/4" dowels into concrete at 1 per 4 square feet.

### 3.10 LABELING

- A. All equipment, panels, controls, safety switches, and devices shall be provided with permanent black laminated white core labels with 3/8" letters.
- B. This shall also apply to all controllers, remote start/stop push buttons, equipment cabinets, and where directed by the A/E.
- C. This shall not apply to local room thermostats and light switches.

### 3.11 FLASHING AND COUNTERFLASHING

- A. Piping and conduit through the roof shall be flashed by the General Contractor. This contractor shall furnish counterflashing.
- B. Ductwork through the roof and roof mounted duct connected equipment shall be provided with prefabricated roof curbs. General contractor shall flash. This contractor shall counterflash.
- C. Structural dunnage for roof mounted equipment shall be flashed and counterflashed. Prefabricated roof curbs may be utilized.

### 3.12 ACCESS

- A. Locate all equipment, valves, devices, and controllers which may need service in accessible places.
- B. Where access is not available; access panels shall be provided. Furnish prime painted steel access doors to the General Contractor for installation.
- C. Access doors shall be 16 gauge frames and 22 gauge steel door. Access doors in fire rated walls shall have a "B" label for 1 ½ hours.
- D. Maintain clearances for tube removal, coil pulls, and filter removal.

### 3.13 WIRING



- A. Power wiring shall be provided by the Division 26 Electrical Contractor. This contractor shall furnish all 3 phase starters, pushbuttons, and controllers necessary to operate the equipment. The Electrical Contractor shall store and install the electrical devices and furnish and install the power wiring.
- B. Control wiring shall be furnished and installed under Division 23 portion of the work. Wiring for controls is control wiring whether it is line voltage or low voltage.
- C. All wiring shall be in accordance with the NEC.
- D. Pushbuttons shall be maintain-contact type.
- E. Refer to the electrical specifications for wiring methods.
- F. Plenum rated cable is required for control wiring.

### 3.14 UTILITIES

- A. Do not interrupt any utility or service without adequate previous notice and scheduling with the owner.
- B. Refer to Division 1 for requirements for providing temporary utilities.

### 3.15 CUTTING AND PATCHING EXTERIOR SERVICES

- A. This contractor shall be responsible for returning disturbed areas to original condition where excavation for utilities has been required.
- B. Cut and patch paved areas to match original surfaces.
- C. Properly tamp backfill before finishing surfaces.
- D. Concrete pavements and curbs shall be formed and poured to match adjacent areas.
- E. Grass areas shall be sodded and maintained until established growth is achieved.

### 3.16 GUARANTEE

- A. All work shall be guaranteed to be free from defects for a period of one year of operation from date of acceptance by the owner unless otherwise specified. Material and labor for first year warranty is to be provided.
- B. Guarantee shall be extended for all non-operational periods due to failure within the guarantee period.
- C. Compressors and refrigeration system components shall be provided with a 5 year factory warranty. Material only for years 2 through 5 is required.

### 3.17 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver material and equipment in manufacturer's original cartons or on skids.
- B. Store material in dry enclosures or under protective coverings out of way of work progress.
- C. Handle so as to prevent damage to product or any surrounding material.

### 3.18 MANUFACTURERS' NAMES

- A. Manufacturers' names are included herein to establish those suppliers who may provide products for this project subject to the requirements of the specifications. Although a manufacturer's name may appear as an acceptable supplier it is not understood that a standard product is acceptable. Products must also meet the technical, performance, and physical requirements of the project as

well as being named in the specification. Any deviations from this must be acknowledged at bid time by the supplier and he shall be solely responsible for any and all costs associated with the application of his product in the project.

- B. A design cannot be prepared which accommodates the installation of all suppliers and is not intended to do so. If certain modifications must be made to accommodate one particular supplier's equipment it shall be considered the contractor's responsibility to arrange for such accommodations and be financially responsible for same.

### 3.19 AS-BUILT DRAWINGS

- A. At the completion of the work the contractor shall furnish a reproducible as-built drawings to the A/E for approval. The drawings shall indicate all work installed and its actual size and location. If acceptable, the A/E will submit the as-built drawings to the owner as record drawings. If not acceptable, the A/E will return the drawing to the contractor to make corrections as required. The contractor will resubmit for approval.
- B. The as-built drawings shall indicate measured dimensions of underground lines and other concealed work.

### 3.20 PENETRATION SEALING

- A. All penetrations of Natatorium walls, fire walls, smoke walls, and floors by ducts, pipes, conduit, or wiring shall be sealed to prevent the flow of gasses or smoke.
- B. The sealant shall be foamed in place between the penetrant and the adjacent floor or wall with DOW Corning RTV foam or equivalent by 3M, Hilti, or Chase foam.
- C. The installation shall meet the approval of the authority having jurisdiction.
- D. Penetrations through rated surfaces shall have a UL rating equivalent to the adjacent surfaces.
- E. All other penetrations of walls either above ceilings or exposed shall be closely sealed around the penetration with caulking or packing to prevent flow of air or sound through the wall.

### 3.21 CUTTING AND PATCHING INTERIOR SURFACES

- A. Respective contractor shall install all hangers, supports, pipe sleeves in floors, walls, partitions, ceilings, and roof slabs as construction progresses to permit their work to be built into place and to eliminate unnecessary cutting of construction work.
- B. All cutting of concrete, or other material for the passage of piping and ductwork through floors, walls, partitions, and ceiling shall be done by the respective contractor where necessary to install his work. Respective contractor will close all such openings around piping, ductwork, and conduit with materials equivalent to that removed. All exposed surfaces shall be left in suitable condition for refinishing without further work.
- C. Contractor shall patch and repair any existing openings created by the demolition work in floors, walls, partitions, and ceilings not being reused for the new construction.

### 3.22 INVERTS AND ELEVATIONS

- A. Indicated inverts and elevations of existing utilities are approximate and based on the best information available.
- B. Upon of award of contract, contractor shall verify in the field all such information and report any discrepancies before proceeding with work. Contractor shall be responsible for extra work caused

by his failure to verify inverts and elevations.

### 3.23 CONNECTIONS TO EQUIPMENT FURNISHED BY OTHERS

- A. Furnish and install final connections to equipment furnished in other parts of the specification or furnished by the owner. Provide drainage connections, vent connections, water connections, fuel gas connections, duct connections, gas connections to the fixtures or equipment. Plumbing connections shall include valved supplies and trapped waste connections.

### 3.24 CONNECTIONS TO EXISTING SYSTEMS

- A. The contractor shall be responsible for connecting new systems to existing systems.
- B. Arrange for outages with the owner.
- C. Contractor shall shut down and drain existing systems.
- D. Contractor shall cut in, weld, solder, or thread, and make connections compatible with existing systems.
- E. Provide new valves at connections to existing systems.
- F. Contractor shall refill existing and fill new systems.
- G. Contractor shall purge air from systems, both new and existing.
- H. Contractor shall place existing systems back into operation.
- I. Contractor shall repair and replace any insulation damaged or removed during connection procedures.

### 3.25 COORDINATION DRAWINGS

- A. Provide 3/8" = 1'-0" scale drawings showing all coordinated ductwork, piping, conduit, and equipment of all trades.
- B. The sheet metal shop drawings may be used as the basis of these drawings.
- C. Show ductwork, walls, beams, steel, drainage piping, domestic water piping, HVAC piping, sprinkler piping, light fixtures, electrical conduit, and equipment.
- D. Contact other disciplines and obtain information to identify fully coordinated systems.
- E. Submit for review and approval to the A/E.
- F. Provide all dimensional data and necessary clearances to other trades for installation of fixtures and equipment within casework and counter tops.
- G. Work shall not proceed until coordination is completed and all conflicts, issues, sequences etc., are resolved.

### 3.26 WELDING

- A. All electric power for arc welding shall be supplied by the contractor performing the work.

### 3.27 VEHICLES

- A. Vehicle access to the site will be as directed by the owner.

### 3.28 RUBBISH DISPOSAL

- A. Burning of debris on the site shall not be permitted. All debris, refuse, and waste shall be removed

from the premises at regular intervals. No accumulation shall be permitted.

### 3.29 PROTECTION

- A. Maintain all public walks and access ways.
- B. Erect and maintain barricades, warning signs, and other protective means as may be directed by the owner for protection of all persons and property from injury or damage.

### 3.30 SCAFFOLDING

- A. The contractor shall at his own expense, install, operate, protect, and maintain temporary services such as scaffolding, material hoists, access walks, etc., as may be required.

### 3.31 UTILITIES

- A. The contractor may use the existing water and electric power for temporary construction needs.
- B. The owner will direct where these services may be tapped.
- C. Those services that are used during construction, but are to remain, shall be refurbished to as new condition before turning back to the owner.

### 3.32 CLEANUP

- A. Remove all visible temporary tags or labels as well as any protective coverings and wrappings from fixtures and equipment.
- B. Remove all spots, stains, soil, paint, spackle, and other foreign matter from all finished work.
- C. Clean and polish all plumbing fixtures.
- D. Remove all trash and debris from the premises.

### 3.33 MOUNTING HEIGHTS

- A. Contractor to coordinate all mounting heights with all trades and architect prior to rough-in.
- B. Maximum thermostat mounting height (top of thermostat) in accordance with ADA.
  - 1. Side reach: 48" A.F.F.
  - 2. Forward reach: 48" A.F.F.

### 3.34 WORK COMPLETION

- A. The contractor shall promptly correct work rejected by the engineer failing to conform to the requirements of the contract documents, whether discovered before or after substantial completion and whether or not fabricated, installed or completed. Costs of correcting such rejected work, including additional testing and inspections and compensation for the engineer's services and expenses made necessary thereby, shall be at the contractor's expense.

### 3.35 REQUEST FOR INFORMATION (RFI) REQUIREMENTS

- A. All RFI's shall include the following information based on AIA Document G716:
  - 1. To, From, Project Name, Issue Date, RFI number in sequential order with all other trades,

Requested Reply Date.

2. Provide a description with specification and/or drawing references.
3. Provide the senders recommendation including cost and/or schedule considerations.
4. Provide receiver's reply space.
5. Note an RFI reply is not an authorization to proceed with the work involving additional cost/time.

3.36 SHOP DRAWING REQUIREMENTS

A. The following is a list of required shop drawings for the project. Not all items may be identified, and it is the responsibility of the contractor to submit additional shop drawings where indicated in the specifications.

HVAC	DATE REC'D	ACTION	DATE REC'D	ACTION
COORDINATION DRAWINGS				
PIPING FLEX CONNECTION				
GAUGES				
THERMOMETERS				
AUTOMATIC CONTROL VALVES				
VALVES - ALL TYPES				
STRAINERS				
CHECK VALVES				
PRESSURE REDUCING VALVE				
PIPING				
VIBRATION ISOLATION				
INSULATION A. Piping B. Ductwork C. Equipment				
SHEET METAL DRAWINGS				
UNIT HEATERS				
CONVECTORS				
FANS				
SPLIT SYSTEMS				

<b>HVAC</b>	<b>DATE REC'D</b>	<b>ACTION</b>	<b>DATE REC'D</b>	<b>ACTION</b>
PACKAGED UNITS				
VAV UNITS				
VAV TERMINALS				
FIRE DAMPERS/RADIANT DAMPERS				
VOLUME DAMPERS				
SMOKE DAMPERS				
GRILLES, REGISTERS, DIFFUSERS				
LOUVERS/ROOF CAPS				
EQUIPMENT CURBS				
AUTOMATIC TEMPERATURE CONTROL A. DEVICES B. WIRING DIAGRAMS C. SEQUENCES				
TEST, BALANCE AND ADJUST REPORT				
AS-BUILT DRAWINGS				
WARRANTIES AND GUARANTEES				
OPERATIONS AND MAINTENANCE MANUALS				
INSTRUCTIONS				
EMERGENCY AND MANUFACTURER CONTACTS				
CONDENSATE PUMPS				

END OF SECTION

## **SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small, and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

#### **1.02 COORDINATION**

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

#### **1.03 SUBMITTALS**

- A. Shop drawing submittals for motorized equipment shall include, but not limited to, the following information on motors provided with equipment.
  - 1. Manufacturer's name and cutsheets.
  - 2. Motor type.
  - 3. Horsepower.
  - 4. Voltage/Phase/Hertz.
  - 5. RPM.
  - 6. Service factor.
  - 7. Insulation class.
  - 8. NEC code number.
  - 9. Motor efficiency and testing method and results.

### **PART 2 - PRODUCTS**

#### **2.01 GENERAL MOTOR REQUIREMENTS**

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. All materials and equipment furnished shall be installed as per manufacturer's requirements and conform to the requirements of Division 26.

#### **2.02 MOTOR CHARACTERISTICS**

- A. Duty: Continuous duty at ambient temperature of 40 deg. C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. Incorporate latest IEEE and NEMA standards.
- D. All copper windings with ball bearings.
- E. Indoors; drip proof, 40 degree C rise.
- F. Outdoors; totally enclosed 55 degree C rise.
- G. Motors over 10 HP to be high efficiency with PF in excess of 0.9.

### 2.03 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

### 2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

### 2.05 SINGLE-PHASE MOTORS



- A. Motors larger than 1/20 hp. shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

## 2.06 MOTOR STARTERS

- A. Fractional with horsepower up to ½ HP; electrical contract.
- B. Polyphase and single phase above ½ HP: this contract.
- C. Electrical contractor shall install all starters except for those provided as an integral part of equipment.
- D. Polyphase starters shall be magnetic combination type, across-the-line electrically operated, electrically held, three pole assemblies, with arc extinguishing characteristics, silver to silver renewable contacts, 3 pole thermal bi-metallic, red run pilot light, individual phase protection, with overload heaters matched to motors installed and with 4 auxiliary contact, Hand-off-Auto switch, and control transformer.
- E. For single phase motors above ½ HP provide magnetic combination single phase motor starters with overloads, non-fusible disconnect switch, red run pilot light, integral 120 volt control transformer with dual primary fusing auxiliary contacts.
- F. Starters shall be as manufactured by G. E., Siemens, Square "D", Cerus or Cutler-Hammer.

## PART 3 - EXECUTION

### 3.01 GENERAL:

- A. Motors shall be leveled, set in true angular and concentric alignment with driven equipment, and bolted firmly to motor base, if not mounted on equipment. Motors's factory-mounted on equipment shall be checked for alignment to driven equipment and mounting bolts shall be checked to ensure bolts are tightly fastened.
- B. Coordination: The Mechanical Contractor shall have the responsibility to provide adequate rough-in information to the Electrical Contractor. Any costs, such as patching and refinishing of walls, resulting from inadequate information shall be the responsibility of the Mechanical Contractor.
- C. For variable frequency drives, refer to Specification 23 09 93.

END OF SECTION

## **SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

1. Section Includes:
2. Slip-joint, packed expansion joints.
3. Metal, compensator packless expansion joints.
4. Rubber union connector packless expansion joints.
5. Flexible hose packless expansion joints.
6. Alignment guides and anchors.
7. Pipe loops and swing connections.

#### **1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed, and sealed by the qualified professional engineer responsible for their preparation.
  1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
  2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

#### **1.03 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

#### **1.04 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

#### **1.05 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.01 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

### 2.02 PACKED EXPANSION JOINTS

- A. Slip-Joint Packed Expansion Joints:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adsko Manufacturing LLC.
    - b. Advanced Thermal Systems, Inc.
    - c. Hyspan Precision Products, Inc.
    - d. Mason Industries, Inc.
  - 2. Standard: ASTM F 1007.
  - 3. Material: Carbon steel with asbestos-free PTFE packing.
  - 4. Design: With internal guide and injection ports for repacking under full system pressure. Housing shall be furnished with drain ports and lifting ring. Include drip connection if used for steam piping.
  - 5. Configuration: [Single joint] [Single joint with base] [and] [double joint with base] class(es), unless otherwise indicated.
  - 6. Slip Tube for sizes NPS 1 ½ inch through NPS 16-inch: Schedule 80.
  - 7. Sliding Surface: 2 mil thick chrome finish.
  - 8. End Connections: Flanged or welded ends to match piping system.

### 2.03 PACKLESS EXPANSION JOINTS

- A. Metal, Compensator Packless Expansion Joints:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flex-Hose Co., Inc.
    - b. Flexicraft Industries.
    - c. Flex-Weld, Inc.
    - d. Hyspan Precision Products, Inc.
    - e. Mason Industries, Inc.
    - f. Metraflex Company (The).
  - 2. Minimum Pressure Rating: [150 psig] [175 psig] [200 psig], unless otherwise indicated.
  - 3. Description: Totally enclosed, externally pressurized, multi-ply bellows isolated from fluid flow by an internal pipe sleeve and external housing.
  - 4. Joint Axial Movement: 2 inches of compression and 1/2 inch of extension.
  - 5. Configuration for Copper Tubing: Multi-ply, phosphor-bronze bellows with copper pipe ends.
    - a. End Connections for Copper Tubing NPS 2-inch and Smaller: Solder joint or

- threaded.
- b. End Connections for Copper Tubing NPS 2 ½ -inch to NPS 4-inch: Threaded.
- 6. Configuration for Steel Piping: Multi-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.
  - a. End Connections for Steel Pipe NPS 2-inch and Smaller: Threaded.
  - b. End Connections for Steel Pipe NPS 2 ½ -inch to NPS 4-inch: Flanged.
- B. Rubber Union Connector Expansion Joints:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amber/Booth Company, Inc.; a VMC Group Company.
    - b. Flex-Hose Co., Inc.
    - c. Flexicraft Industries.
    - d. Mason Industries, Inc.
  - 2. Material: Twin reinforced-rubber spheres [ with external restraining cables].
  - 3. Minimum Pressure Rating: 150 psig at 170 deg. F, unless otherwise indicated.
  - 4. End Connections for NPS 2-inch and Smaller: Threaded.
- C. Flexible-Hose Packless Expansion Joints:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flex Pression Ltd.
    - b. Flex-Hose Co., Inc.
    - c. Flexicraft Industries.
    - d. Mason Industries, Inc.
    - e. Metraflex Company (The).
  - 2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
  - 3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
  - 4. Expansion Joints for Copper Tubing NPS 2-inch and Smaller: Copper-alloy fittings with solder-joint end connections.
    - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg. F and 340 psig at 450 deg. F ratings.
  - 5. Expansion Joints for Copper Tubing NPS 2 ½ -inch to NPS 4-inch: Copper alloy fittings with threaded end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg. F and 225 psig at 450 deg. F ratings.
  - 6. Expansion Joints for Steel Piping NPS 2-inch and Smaller: Carbon-steel fittings with threaded end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg. F and 325 psig at 600 deg. F ratings.
  - 7. Expansion Joints for Steel Piping NPS 2 ½ -inch to NPS 6-inch: Carbon-steel fittings with [flanged] [welded] end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg. F and 145 psig at 600 deg. F ratings.

## 2.04 ALIGNMENT GUIDES AND ANCHORS

### A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adsc0 Manufacturing LLC.
    - b. Advanced Thermal Systems, Inc.
    - c. Flex-Hose Co., Inc.
    - d. Flexicraft Industries.
    - e. Flex-Weld, Inc.
    - f. Hyspan Precision Products, Inc.
    - g. Mason Industries, Inc.
    - h. Metraflex Company (The).
    - i. Senior Flexonics Pathway.
    - j. U.S. Bellows, Inc.
  2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.
- B. Anchor Materials:
1. Steel Shapes and Plates: ASTM A 36/A 36M.
  2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
  3. Washers: ASTM F 844, steel, plain, flat washers.
  4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
    - a. Stud: Threaded, zinc-coated carbon steel.
    - b. Expansion Plug: Zinc-coated steel.
    - c. Washer and Nut: Zinc-coated steel.
  5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
    - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
    - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
    - c. Washer and Nut: Zinc-coated steel.

### **PART 3 - EXECUTION**

#### **3.01 EXPANSION JOINT INSTALLATION**

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install packed-type expansion joints with packing suitable for fluid service.
- C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

#### **3.02 PIPE LOOP AND SWING CONNECTION INSTALLATION**

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

### 3.03 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
  - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
  - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
  - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION

## **SECTION 23 05 17 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Sleeves.
  2. Sleeve-seal systems.
  3. Grout.

#### 1.02 ACTION SUBMITTALS

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

### **PART 2 - PRODUCTS**

#### 2.01 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

#### 2.02 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Metraflex Company (The).
  5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  2. Pressure Plates: Carbon steel.

3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

### 2.03 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.01 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use joint sealant appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and



make a watertight seal.

### 3.03 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6-inch: Cast-iron wall sleeves.
    - b. Piping NPS 6-inch and Larger: Cast-iron wall sleeves.
  2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6-inch: Cast-iron wall sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6-inch and Larger: Cast-iron wall sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6-inch: Cast-iron wall sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6-inch and Larger: Cast-iron wall sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  4. Concrete Slabs above Grade:
    - a. Piping Smaller Than NPS 6-inch: Galvanized-steel-pipe sleeves.
    - b. Piping NPS 6-inch and Larger: Galvanized-steel-pipe sleeves.
  5. Interior Partitions:
    - a. Piping Smaller Than NPS 6-inch: Galvanized-steel-pipe sleeves.
    - b. Piping NPS 6-inch and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

## **SECTION 23 05 18 - ESCUTCHEONS FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Escutcheons.
  2. Floor plates.

#### 1.02 ACTION SUBMITTALS

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

### **PART 2 - PRODUCTS**

#### 2.01 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With [polished, chrome plated and rough brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring clip fasteners.

#### 2.02 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

### **PART 3 - EXECUTION**

#### 3.01 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep-pattern type.
    - b. Chrome-Plated Piping: One piece, cast-brass type with polished, chrome-

- plated finish.
- c. Insulated Piping: One piece, stamped-steel type.
- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast-brass type with polished, chrome-plated finish.
- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, stamped-steel type.
- f. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast-brass type with polished, chrome-plated finish.
- g. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, stamped-steel type.
- h. Bare Piping in Unfinished Service Spaces: One piece, cast-brass type with polished, chrome-plated finish.
- i. Bare Piping in Unfinished Service Spaces: One piece, stamped-steel type.
- j. Bare Piping in Equipment Rooms: One piece, cast-brass type with polished, chrome-plated finish.
- k. Bare Piping in Equipment Rooms: One piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping: One piece, floor-plate type.

### 3.02 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

## **SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Bimetallic-actuated thermometers.
  - 2. Liquid-in-glass thermometers.
  - 3. Duct-thermometer mounting brackets.
  - 4. Thermowells.
  - 5. Dial-type pressure gages.
  - 6. Gage attachments.
  - 7. Flowmeters.
- B. Related Requirements:
  - 1. Section 232216 "Steam and Condensate Piping Specialties" for steam and condensate meters.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include diagrams for power, signal, and control wiring.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage.

#### 1.04 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### **PART 2 - PRODUCTS**

#### 2.01 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flo Fab Inc.
    - b. Miljoco Corporation.
    - c. Palmer Wahl Instrumentation Group.

- d. Tel-Tru Manufacturing Company.
  - e. Terice, H. O. Co.
  - f. Weiss Instruments, Inc.
  - g. Weksler Glass Thermometer Corp.
  - h. Winters Instruments - U.S.
2. Standard: ASME B40.200.
  3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
  4. Case Form: Adjustable angle unless otherwise indicated.
  5. Tube: Glass with magnifying lens and blue [ or red] organic liquid.
  6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
  7. Window: Glass.
    - a. Stem: Aluminum and of length to suit installation.
    - b. Design for Air-Duct Installation: With ventilated shroud.
    - c. Design for Thermowell Installation: Bare stem.
  8. Connector: 1 ¼ inches, with ASME B1.1 screw threads.
  9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

## 2.02 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

## 2.03 THERMOWELLS

- A. Thermowells:
  1. Standard: ASME B40.200.
  2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
  3. Material for Use with Copper Tubing: CNR.
  4. Material for Use with Steel Piping: CRES.
  5. Type: Stepped shank unless straight or tapered shank is indicated.
  6. External Threads: NPS ½-inch, NPS ¾-inch, or NPS 1-inch, ASME B1.20.1 pipe threads.
  7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
  8. Bore: Diameter required to match thermometer bulb or stem.
  9. Insertion Length: Length required to match thermometer bulb or stem.
  10. Lagging Extension: Include on thermowells for insulated piping and tubing.
  11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.04 DIAL-TYPE PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ametek U.S. Gauge.

- b. Ashcroft Inc.
  - c. Ernst Flow Industries.
  - d. Flo Fab Inc.
  - e. Marsh Bellofram.
  - f. Miljoco Corporation.
  - g. Noshok.
  - h. Palmer Wahl Instrumentation Group.
  - i. REOTEMP Instrument Corporation.
  - j. Tel-Tru Manufacturing Company.
  - k. Trerice, H. O. Co.
  - l. Watts; a Watts Water Technologies company.
  - m. Weiss Instruments, Inc.
  - n. Weksler Glass Thermometer Corp.
  - o. WIKA Instrument Corporation.
  - p. Winters Instruments - U.S.
2. Standard: ASME B40.100.
  3. Case: Sealed type(s); cast aluminum or drawn steel; 4 ½- inch nominal diameter.
  4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
  5. Pressure Connection: Brass, with NPS ¼-inch or NPS ½-inch, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  6. Movement: Mechanical, with link to pressure element and connection to pointer.
  7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
  8. Pointer: Dark-colored metal.
  9. Window: Glass.
  10. Ring: Metal.
  11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## 2.05 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS ¼-inch or NPS ½-inch, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass pipe with NPS ¼-inch or NPS ½-inch pipe threads.
- C. Valves: Brass ball, with NPS ¼-inch or NPS ½-inch, ASME B1.20.1 pipe threads.

## 2.06 FLOWMETERS

- A. Pitot-Tube Flowmeters:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ABB.
    - b. Emerson Process Management; Rosemount Division.
    - c. Meriam Process Technologies.
    - d. Nexus Valve, Inc.
    - e. Preso Meters.
    - f. TACO Comfort Solutions, Inc.
    - g. Veris Inc.

2. Description: Flowmeter with sensor and indicator.
  3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
  4. Sensor: Insertion type; for inserting probe in piping and measuring flow directly in gallons per minute.
    - a. Design: Differential-pressure-type measurement for oil.
    - b. Construction: Stainless-steel probe of length to span inside of pipe, with integral transmitter and direct-reading scale.
    - c. Minimum Pressure Rating: 150 psig.
    - d. Minimum Temperature Rating: 250 deg. F.
  5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
  6. Integral Transformer: For low-voltage power connection.
  7. Accuracy: Plus or minus 3 percent.
  8. Display: Shows rate of flow with register to indicate total volume in gallons.
  9. Operating Instructions: Include complete instructions with each flowmeter.
- B. Turbine Flowmeters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ABB.
    - b. EMCO Flow Systems.
    - c. ERDCO Engineering Corp.
    - d. Hoffer Flow Controls, Inc.
    - e. Liquid Controls.
    - f. McCrometer, Inc.
    - g. Midwest Instruments & Controls Corp.
    - h. ONICON Incorporated.
    - i. SeaMetrics, Inc.
    - j. Sponsler, Inc.
  2. Description: Flowmeter with sensor and indicator.
  3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
  4. Sensor: Impeller turbine; for inserting in pipe fitting or for installing in piping and measuring flow directly in gallons per minute.
    - a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for [gas] [oil] [steam] [water] <Insert fluid>.
    - b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
    - c. Minimum Pressure Rating: 150 psig.
    - d. Minimum Temperature Rating: 180 deg. F.
  5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
  6. Accuracy: Plus or minus 1 ½ percent.
  7. Display: Shows rate of flow, with register to indicate total volume in gallons.
  8. Operating Instructions: Include complete instructions with each flowmeter.
- C. Venturi Flowmeters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ABB.
    - b. Gerand Engineering Co.
    - c. Hyspan Precision Products, Inc.

- d. Nexus Valve, Inc.
- e. Preso Meters.
- f. S. A. Armstrong Limited.
- g. Victaulic Company.
2. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.
  - a. Design: Differential-pressure-type measurement for [gas] [oil] [steam] [water] <Insert fluid>.
  - b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
  - c. Minimum Pressure Rating: 250 psig.
  - d. Minimum Temperature Rating: 250 deg. F.
  - e. End Connections for NPS 2-inch and Smaller: Threaded.
  - f. End Connections for NPS 2 ½ -inch and Larger: Flanged or welded.
  - g. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.
5. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch-diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
  - a. Scale: Gallons per minute.
  - b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.
6. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flowmeter element and having two 12-foot hoses, with carrying case.
  - a. Scale: Gallons per minute.
  - b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.
7. Display: Shows rate of flow, with register to indicate total volume in gallons.
8. Conversion Chart: Flow rate data compatible with sensor.
9. Operating Instructions: Include complete instructions with each flowmeter.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install thermowells with socket extending one-third of pipe diameter to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels;



- connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
  - H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
  - I. Install valve and snubber in piping for each pressure gage for fluids (except steam).
  - J. Install valve and syphon fitting in piping for each pressure gage for steam.
  - K. Install test plugs in piping tees.
  - L. Install flow indicators in piping systems in accessible positions for easy viewing.
  - M. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
  - N. Install flowmeter elements in accessible positions in piping systems.
  - O. Install wafer-orifice flowmeter elements between pipe flanges.
  - P. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.
  - Q. Install permanent indicators on walls or brackets in accessible and readable positions.
  - R. Install connection fittings in accessible locations for attachment to portable indicators.
  - S. Install thermometers in the following locations:
    1. Inlet and outlet of each hydronic zone.
    2. Inlet and outlet of each hydronic coil in air-handling units.
    3. Two inlets and two outlets of each hydronic heat exchanger.
    4. Inlet and outlet of each thermal-storage tank.
    5. Outside, return, supply, and mixed-air ducts.
  - T. Install pressure gages in the following locations:
    1. Discharge of each pressure-reducing valve.
    2. Suction and discharge of each pump.

### 3.02 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow space for service and maintenance of meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.
- D. Connect thermal-energy meter transmitters to meters.

### 3.03 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

### 3.04 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic zone shall be the following:
  1. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:
  1. Liquid-filled type.
- C. Thermometers at inlets and outlets of each hydronic heat exchanger shall be the following:

- 1. Liquid-filled type.
- D. Thermometers at outside, return, supply, and mixed-air ducts shall be the following:
  - 1. Liquid-filled type.
- E. Thermometer stems shall be of length to match thermowell insertion length.

### 3.05 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: Minus 40 to plus 160 deg. F.
- B. Scale Range for Chilled-Water Piping: 0 to 150 deg. F.
- C. Scale Range for Heating, Hot-Water Piping: 20 to 240 deg. F.
- D. Scale Range for Steam and Steam-Condensate Piping: 0 to 250 deg. F.
- E. Scale Range for Air Ducts: 0 to 150 deg. F.

### 3.06 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each pressure-reducing valve shall be the following:
  - 1. Liquid-filled Sealed-mounted, metal case.
- B. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be the following:
  - 1. Liquid-filled Sealed-mounted, metal case.
- C. Pressure gages at suction and discharge of each pump shall be the following:
  - 1. Liquid-filled Sealed-mounted, metal case.

### 3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 160 psi.
- B. Scale Range for Heating, Hot-Water Piping: 0 to 160 psi.
- C. Scale Range for Steam Piping: 0 to 160 psi.

### 3.08 FLOWMETER SCHEDULE

- A. Flowmeters for Chilled-Water Piping: Pitot-tube or Venturi type.
- B. Flowmeters for Heating, Hot-Water Piping: Pitot-tube or Venturi type.
- C. Flowmeters for Steam and Steam-Condensate Piping: Turbine or Venturi type.

END OF SECTION

## **SECTION 23 05 23.11 - GLOBE VALVES FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

A. Section Includes:

1. Bronze globe valves.
2. Iron globe valves.
3. Chainwheels.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded-end valves.
  2. ASME B16.1 for flanges on iron valves.
  3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  4. ASME B16.18 for solder joint connections.
  5. ASME B31.1 for power piping valves.
  6. ASME B31.9 for building services piping valves.
- C. Refer to HVAC valve schedule articles for applications of valves.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valves in Insulated Piping: With 2-inch stem extensions.

#### 2.02 BRONZE GLOBE VALVES

- A. Bronze Globe Valves, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.

- c. Milwaukee Valve Company.
    - d. NIBCO INC.
    - e. Powell Valves.
    - f. Stockham; Crane Energy Flow Solutions.
    - g. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 1.
    - b. CWP Rating: 200 psig.
    - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
    - d. Ends: Threaded or solder joint.
    - e. Stem and Disc: Bronze.
    - f. Packing: Asbestos free.
    - g. Handwheel: Malleable iron.
- B. Bronze Globe Valves, Class 150:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
    - e. Powell Valves.
    - f. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 2.
    - b. CWP Rating: 300 psig.
    - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
    - d. Ends: Threaded.
    - e. Stem: Bronze.
    - f. Disc: Bronze.
    - g. Packing: Asbestos free.
    - h. Handwheel: Malleable iron.

### 2.03 IRON GLOBE VALVES

- A. Iron Globe Valves, Class 125:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Jenkins Valves; Crane Energy Flow Solutions.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Powell Valves.
    - g. Stockham; Crane Energy Flow Solutions.
    - h. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-85, Type I.
    - b. CWP Rating: 200 psig.

- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Packing and Gasket: Asbestos free.
  - g. Operator: Handwheel or chainwheel.
- B. Iron Globe Valves, Class 250:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Jenkins Valves; Crane Energy Flow Solutions.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Stockham; Crane Energy Flow Solutions.
    - g. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-85, Type I.
    - b. CWP Rating: 500 psig.
    - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    - d. Ends: Flanged.
    - e. Trim: Bronze.
    - f. Packing and Gasket: Asbestos free.
    - g. Operator: Handwheel or chainwheel.

#### 2.04 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Babbitt Steam Specialty Co.
  - 2. Roto Hammer Industries.
  - 3. Trumbull Industries.
- A. Description: Valve actuation assembly with sprocket rim, chain guides, chain and attachment brackets for mounting chainwheels directly to handwheels.
  - 1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc or epoxy coating.
  - 2. Chain: Hot-dip-galvanized steel, of size required to fit sprocket rim.

### PART 3 - EXECUTION

#### 3.01 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.

- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for globe valves NPS 4-inch and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

### 3.02 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Throttling Service except Steam: Globe valves.
  - 2. Throttling Service, Steam: Globe valves.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 2-inch and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules.
  - 2. For Copper Tubing, NPS 2 ½ -inch to NPS 4-inch: Flanged ends except where threaded valve-end option is indicated in valve schedules.
  - 3. For Copper Tubing, NPS 5-inch and Larger: Flanged ends.
  - 4. For Steel Piping, NPS 2-inch and Smaller: Threaded ends.
  - 5. For Steel Piping, NPS 2 ½ -inch to NPS 4-inch: Flanged ends except where threaded valve-end option is indicated in valve schedules.
  - 6. For Steel Piping, NPS 5-inch and Larger: Flanged ends.

### 3.04 CHILLED WATER VALVE SCHEDULE

- A. Pipe NPS 2-inch and Smaller: Bronze globe valves, Class 125 Class 150, with bronze disc, and with threaded ends.
- B. Pipe NPS 2 ½ -inch and Larger: Iron globe valves, Class 125 Class 250, with flanged ends.

### 3.05 HEATING WATER VALVE SCHEDULE

- A. Pipe NPS 2-inch and Smaller: Bronze globe valves, Class 125, with bronze disc, and threaded ends.
- B. Pipe NPS 2 ½ -inch and Larger: Iron globe valves, Class 125, with flanged ends.

### 3.06 LOW PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

- A. Pipe NPS 2-inch and Smaller: Bronze globe valves, Class 125 , with bronze disc, and threaded ends.
- B. Pipe NPS 2 ½ -inch and Larger: Iron globe valves, Class 125, with flanged ends.

### 3.07 HIGH PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)

- A. Pipe NPS 2-inch and Smaller: Bronze globe valves, Class 150, with bronze disc, and threaded ends.
- B. Pipe Sizes NPS 2 ½ -inch and Larger: Iron globe valves, Class 250.

### 3.08 STEAM CONDENSATE VALVE SCHEDULE

- A. Pipe NPS 2-inch and Smaller: Bronze globe valves, Class 125, with bronze disc, and threaded ends.
- B. Pipe NPS 2 ½ -inch and Larger: Iron globe valves, Class 125.

END OF SECTION

## **SECTION 23 05 23.12 - BALL VALVES FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Bronze ball valves.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded-end valves.
  2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  3. ASME B16.18 for solder-joint connections.
  4. ASME B31.1 for power piping valves.
  5. ASME B31.9 for building services piping valves.
- C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Refer to HVAC valve schedule articles for applications of valves.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 4-inch and larger.
  2. Handlever: For quarter-turn valves smaller than NPS 4-inch.
- H. Valves in Insulated Piping:
1. Include 2-inch stem extensions.
  2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
  3. Memory stops that are fully adjustable after insulation is applied.
- I. Valve Bypass and Drain Connections: MSS SP-45.



## 2.02 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two-Piece with Full Port and Bronze or Brass Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Valve, Inc.
    - b. Apollo Valves; Conbraco Industries, Inc.
    - c. Crane; Crane Energy Flow Solutions.
    - d. Hammond Valve.
    - e. Legend Valve & Fitting, Inc.
    - f. Milwaukee Valve Company.
    - g. NIBCO INC.
    - h. Watts; a Watts Water Technologies company.
  2. Description:
    - a. Standard: MSS SP-110.
    - b. SWP Rating: 150 psig.
    - c. CWP Rating: 600 psig.
    - d. Body Design: Two piece.
    - e. Body Material: Bronze.
    - f. Ends: Threaded.
    - g. Seats: PTFE.
    - h. Stem: Bronze.
    - i. Ball: Chrome-plated brass.

## PART 3 - EXECUTION

### 3.01 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

### 3.02 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- B. Select valves with the following end connections:
  1. For Copper Tubing, NPS 2-inch and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  2. For Steel Piping, NPS 2-inch and Smaller: Threaded ends.

### 3.03 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2-inch and Smaller: Bronze ball valves, two pieces, with bronze trim, and full port.
  - 1. Valves may be provided with solder-joint ends instead of threaded ends.

#### 3.04 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2-inch and Smaller: Bronze ball valves, two pieces, with bronze trim, and full port.
  - 1. Valves may be provided with solder-joint ends instead of threaded ends.

#### 3.05 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

- A. Pipe NPS 2-inch and Smaller: Bronze ball valves, two pieces with bronze trim, and full port.

#### 3.06 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)

- A. Pipe NPS 2-inch and Smaller: Bronze, two pieces with bronze trim, and full port.

#### 3.07 STEAM-CONDENSATE VALVE SCHEDULE

- A. Pipe NPS 2-inch and Smaller: Bronze ball valves, two pieces, with bronze trim, and full port.

END OF SECTION

## **SECTION 23 05 23.13 - BUTTERFLY VALVES FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Iron, single-flange butterfly valves.
  2. High-performance butterfly valves.
  3. Chainwheels.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B16.1 for flanges on iron valves.
  2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  3. ASME B31.1 for power piping valves.
  4. ASME B31.9 for building services piping valves.
- C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream piping unless otherwise indicated.
- E. Valve Actuator Types:
1. Gear Actuator: For valves NPS 8-inch and larger.
  2. Handlever: For valves NPS 6-inch and smaller.
  3. Chainwheel: Device for attachment to gear, stem, or other actuator of size and with chain for mounting height, according to "Valve Installation" Article.
- F. Valves in Insulated Piping: With 2-inch stem extensions with extended necks.

#### 2.02 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. Iron, Single-Flange Butterfly Valves with Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; Conbraco Industries, Inc.

- b. Hammond Valve.
  - c. Jenkins Valves; Crane Energy Flow Solutions.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Spence Engineering Company, Inc.
  - g. Stockham; Crane Energy Flow Solutions.
  - h. Tyco Valves & Controls.
  - i. Watts; a Watts Water Technologies company.
2. Description:
- a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 150 psig 200 psig.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
  - e. Seat: EPDM.
  - f. Stem: One or two-piece stainless steel.
  - g. Disc: Aluminum bronze.
- A. Iron, Single-Flange Butterfly Valves with Ductile-Iron Disc:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; Conbraco Industries, Inc.
    - b. Center Line; Crane Energy Flow Solutions.
    - c. Hammond Valve.
    - d. Jomar Valve.
    - e. Milwaukee Valve Company.
    - f. Mueller Steam Specialty.
    - g. NIBCO INC.
    - h. Spence Engineering Company, Inc.
    - i. Stockham; Crane Energy Flow Solutions.
    - j. Tyco Valves & Controls.
    - k. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-67, Type I.
    - b. CWP Rating: 150 psig 200 psig.
    - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
    - e. Seat: EPDM.
    - f. Stem: One- or two-piece stainless steel.
    - g. Disc: Nickel-plated ductile iron.
- B. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; Conbraco Industries, Inc.
    - b. Hammond Valve.
    - c. Jenkins Valves; Crane Energy Flow Solutions.
    - d. Milwaukee Valve Company.
    - e. Mueller Steam Specialty.

- f. NIBCO INC.
  - g. Spence Engineering Company, Inc.
  - h. Stockham; Crane Energy Flow Solutions.
  - i. Tyco Valves & Controls.
  - j. Watts; a Watts Water Technologies company.
2. Description:
- a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 150 psig 200 psig.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
  - e. Seat: EPDM.
  - f. Stem: One- or two-piece stainless steel.
  - g. Disc: Stainless steel.

## 2.03 HIGH-PERFORMANCE BUTTERFLY VALVES

- A. Single-Flange, High-Performance Butterfly Valves, Class 150:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flowseal; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Jamesbury; Metso.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Process Development & Control, Inc.
    - g. Stockham; Crane Energy Flow Solutions.
    - h. Tyco Valves & Controls.
    - i. XOMOX; Crane Chempharma Flow Solutions.
  - 2. Description:
    - a. Standard: MSS SP-68.
    - b. CWP Rating: 285 psig at 100 deg. F.
    - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    - d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
    - e. Seat: Reinforced PTFE or metal.
    - f. Stem: Stainless steel; offset from seat plane.
    - g. Disc: Carbon steel.
    - h. Service: Bidirectional.
- B. Single-Flange, High-Performance Butterfly Valves, Class 300:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flowseal; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Jamesbury; Metso.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Stockham; Crane Energy Flow Solutions.

- g. Tyco Valves & Controls.
- h. XOMOX; Crane Chempharma Flow Solutions.
- 2. Description:
  - a. Standard: MSS SP-68.
  - b. CWP Rating: 720 psig at 100 deg. F.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: Carbon steel, cast iron, or ductile iron.
  - e. Seat: Reinforced PTFE or metal.
  - f. Stem: Stainless steel; offset from seat plane.
  - g. Disc: Carbon steel.
  - h. Service: Bidirectional.

#### 2.04 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Babbitt Steam Specialty Co.
  - 2. Roto Hammer Industries.
  - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to hand wheels.
  - 1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve include zinc or epoxy coating.
  - 2. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

### PART 3 - EXECUTION

#### 3.01 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for butterfly valves NPS 4-inch and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

#### 3.02 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

#### 3.03 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 ½ -inch and Larger:
  - 1. Iron, Single-Flange Butterfly Valves, NPS 2 ½ - inch to NPS 12-inch: Aluminum-bronze, 200 CWP, and EPDM seat.

3.04 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 ½ -inch and Larger:
  - 1. Iron, Single-Flange Butterfly Valves, NPS 2 ½ -inch to NPS 12-inch: Aluminum-bronze 200 CWP, and EPDM seat.

3.05 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

- A. Pipe NPS 2 ½ -inch and Larger: High-performance butterfly valves, single flange, Class 150

3.06 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)

- A. Pipe NPS 2 ½ -inch and Larger: High-performance butterfly valves, single flange, Class 150

3.07 STEAM-CONDENSATE VALVE SCHEDULE

- A. Pipe NPS 2 ½ -inch and Larger: High-performance butterfly valves, single flange, Class 150

END OF SECTION

## **SECTION 23 05 23.14 - CHECK VALVES FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Bronze swing check valves.
  2. Iron swing check valves.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded-end valves.
  2. ASME B16.1 for flanges on iron valves.
  3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  4. ASME B16.18 for solder joint.
  5. ASME B31.1 for power piping valves.
  6. ASME B31.9 for building services piping valves.
- C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Bypass and Drain Connections: MSS SP-45.

#### 2.02 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Bronze Disc, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Valve, Inc.
    - b. Crane; Crane Energy Flow Solutions.
    - c. Hammond Valve.



- d. Jenkins Valves; Crane Energy Flow Solutions.
- e. Jomar Valve.
- f. KITZ Corporation.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Stockham; Crane Energy Flow Solutions.
- k. Watts; a Watts Water Technologies company.
- 2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: Bronze.
- B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Jenkins Valves; Crane Energy Flow Solutions.
    - d. KITZ Corporation.
    - e. Milwaukee Valve Company.
    - f. NIBCO INC.
    - g. Stockham; Crane Energy Flow Solutions.
    - h. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 4.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B 62, bronze.
    - e. Ends: Threaded.
    - f. Disc: PTFE.
- C. Bronze Swing Check Valves with Bronze Disc, Class 150:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Valve, Inc.
    - b. Crane; Crane Energy Flow Solutions.
    - c. Jenkins Valves; Crane Energy Flow Solutions.
    - d. KITZ Corporation.
    - e. Milwaukee Valve Company.
    - f. NIBCO INC.
    - g. Stockham; Crane Energy Flow Solutions.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 3.
    - b. CWP Rating: 300 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B 62, bronze.

- e. Ends: Threaded.
- f. Disc: Bronze.
- D. Bronze Swing Check Valves with Nonmetallic Disc, Class 150:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Jenkins Valves; Crane Energy Flow Solutions.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 4.
    - b. CWP Rating: 300 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B 62, bronze.
    - e. Ends: Threaded.
    - f. Disc: PTFE.

### 2.03 IRON SWING CHECK VALVES

- A. Iron Swing Check Valves with Metal Seats, Class 125:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Jenkins Valves; Crane Energy Flow Solutions.
    - d. KITZ Corporation.
    - e. Legend Valve & Fitting, Inc.
    - f. Milwaukee Valve Company.
    - g. NIBCO INC.
    - h. Stockham; Crane Energy Flow Solutions.
    - i. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-71, Type I.
    - b. NPS 2 ½ -inch to NPS 12-inch, CWP Rating: 200 psig.
    - c. NPS 14-inch to NPS 24-inch, CWP Rating: 150 psig.
    - d. Body Design: Clear or full waterway.
    - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
    - f. Ends: Flanged.
    - g. Trim: Bronze.
    - h. Gasket: Asbestos free.
- B. Iron Swing Check Valves with Nonmetallic-to-Metal Seats, Class 125:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Stockham; Crane Energy Flow Solutions.
  - 2. Description:

- a. Standard: MSS SP-71, Type I.
  - b. NPS 2 ½ -inch to NPS 12-inch, CWP Rating: 200 psig.
  - c. NPS 14-inch to NPS 24-inch, CWP Rating: 150 psig.
  - d. Body Design: Clear or full waterway.
  - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - f. Ends: Flanged.
  - g. Trim: Composition.
  - h. Seat Ring: Bronze.
  - i. Disc Holder: Bronze.
  - j. Disc: PTFE.
  - k. Gasket: Asbestos free.
- C. Iron Swing Check Valves with Metal Seats, Class 250:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. Jenkins Valves; Crane Energy Flow Solutions.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Stockham; Crane Energy Flow Solutions.
    - g. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-71, Type I.
    - b. NPS 2 ½ -inch to NPS 12-inch, CWP Rating: 500 psig.
    - c. NPS 14-inch to NPS 24-inch, CWP Rating: 300 psig.
    - d. Body Design: Clear or full waterway.
    - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
    - f. Ends: Flanged.
    - g. Trim: Bronze.
    - h. Gasket: Asbestos free.

#### 2.04 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Iron Swing Check Valves with Lever- and Spring-Closure Control, Class 125:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. NIBCO INC.
  - 2. Description:
    - a. Standard: MSS SP-71, Type I.
    - b. NPS 2 ½ -inch to NPS 12-inch, CWP Rating: 200 psig.
    - c. NPS 14-inch to NPS 24-inch, CWP Rating: 150 psig.
    - d. Body Design: Clear or full waterway.
    - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
    - f. Ends: Flanged.
    - g. Trim: Bronze.
    - h. Gasket: Asbestos free.
    - i. Closure Control: Factory installed, exterior lever and spring.
- B. Iron Swing Check Valves with Lever and Weight-Closure Control, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane; Crane Energy Flow Solutions.
  - b. Hammond Valve.
  - c. Jenkins Valves; Crane Energy Flow Solutions.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Stockham; Crane Energy Flow Solutions.
  - g. Watts; a Watts Water Technologies company.
2. Description:
  - a. Standard: MSS SP-71, Type I.
  - b. NPS 2 ½ -inch to NPS 12-inch, CWP Rating: 200 psig.
  - c. NPS 14-inch to NPS 24-inch, CWP Rating: 150 psig.
  - d. Body Design: Clear or full waterway.
  - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - f. Ends: Flanged.
  - g. Trim: Bronze.
  - h. Gasket: Asbestos free.
  - i. Closure Control: Factory-installed, exterior lever and weight.

### **PART 3 - EXECUTION**

#### **3.01 VALVE INSTALLATION**

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

#### **3.02 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

#### **3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valve applications are not indicated, use the following:
  1. Pump-Discharge Check Valves:
    - a. NPS 2-inch and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2 ½ -inch and Larger: Iron swing check valves with lever and weight or with spring; metal-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are unavailable, the same types of

valves with higher SWP classes or CWP ratings may be substituted.

- C. Select valves, except wafer.
1. For Copper Tubing, NPS 2-inch and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules.
  2. For Copper Tubing, NPS 2 ½ -inch to NPS 4-inch: Flanged ends except where threaded valve-end option is indicated in valve schedules.
  3. For Copper Tubing, NPS 5-inch and Larger: Flanged ends.
  4. For Steel Piping, NPS 2-inch and Smaller: Threaded ends.
  5. For Steel Piping, NPS 2 ½ to NPS 4-inch: Flanged ends except where threaded valve-end option is indicated in valve schedules.
  6. For Steel Piping, NPS 5-inch and Larger: Flanged ends.

### 3.04 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2-inch and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
  2. Bronze swing check valves with bronze disc, Class 125
- B. Pipe NPS 2 ½ -inch and Larger:
1. Iron Valves, NPS 2 ½ -inch to NPS 4-inch: May be provided with threaded ends instead of flanged ends.
  2. NPS 2 ½ -inch to NPS 12-inch: Iron swing check valves with lever and spring closure control, Class 125.
  3. Iron swing check valves with metal seats, Class 125.

### 3.05 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2-inch and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
  2. Bronze swing check valves with bronze disc, Class 125.
- B. Pipe NPS 2 ½ -inch and Larger:
1. Iron Valves, NPS 2 ½ -inch to NPS 4-inch: May be provided with threaded ends instead of flanged ends.
  2. NPS 2 ½ -inch to NPS 12-inch: Iron swing check valves with lever and spring-closure control, Class 125.
  3. Iron swing check valves with metal seats, Class 125.

### 3.06 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

- A. Pipe NPS 2-inch and Smaller:
1. Bronze swing check valves with bronze disc, Class 125.
- B. Pipe NPS 2 ½ -inch and Larger:
1. Iron Valves, NPS 2 ½ -inch to NPS 4-inch: May be provided with threaded ends instead of flanged ends.
  2. NPS 2 ½ -inch to NPS 12-inch: Iron swing check valves with lever and spring-closure control, Class 125.
  3. Iron swing check valves with metal seats, Class 125.

### 3.07 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)

- A. Pipe NPS 2-inch and Smaller:
  - 1. Bronze swing check valves with bronze disc, Class 125.
- B. Pipe NPS 2 ½ -inch and Larger:
  - 1. Iron Valves, NPS 2 ½ -inch to NPS 4-inch: May be provided with threaded ends instead of flanged ends.
  - 2. NPS 2 ½ -inch to NPS 12-inch: Iron swing check valves with lever and spring-closure control, Class 125.
  - 3. Iron swing check valves with metal seats, Class 125.

### 3.08 STEAM-CONDENSATE VALVE SCHEDULE

- A. Pipe NPS 2-inch and Smaller:
- B. Bronze swing check valves with bronze disc, Class 125.
- C. Pipe NPS 2 ½ -inch and Larger:
  - 1. Iron Valves, NPS 2 ½ -inch to NPS 4-inch: May be provided with threaded ends instead of flanged ends.
  - 2. NPS 2 ½ -inch to NPS 12-inch: Iron swing check valves with lever and spring-closure control, Class 125.
  - 3. Iron swing check valves with metal seats, Class 125.

END OF SECTION

## **SECTION 23 05 23.15 - GATE VALVES FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Bronze gate valves.
  2. Iron gate valves.
  3. Chainwheels.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded-end valves.
  2. ASME B16.1 for flanges on iron valves.
  3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  4. ASME B16.18 for solder joint.
  5. ASME B31.1 for power piping valves.
  6. ASME B31.9 for building services piping valves.
- C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. RS Valves in Insulated Piping: With 2-inch stem extensions.
- G. Valve Bypass and Drain Connections: MSS SP-45.

#### 2.02 BRONZE GATE VALVES

- A. Bronze Gate Valves, RS, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
  - b. Crane; Crane Energy Flow Solutions.
  - c. Hammond Valve.
  - d. Jenkins Valves; Crane Energy Flow Solutions.
  - e. KITZ Corporation.
  - f. Macomb Groups (The).
  - g. Milwaukee Valve Company.
  - h. NIBCO INC.
  - i. Powell Valves.
  - j. Stockham; Crane Energy Flow Solutions.
  - k. Watts; a Watts Water Technologies company.
2. Description:
- a. Standard: MSS SP-80, Type 2.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
  - d. Ends: Threaded or solder joint.
  - e. Stem: Bronze.
  - f. Disc: Solid wedge; bronze.
  - g. Packing: Asbestos free.
  - h. Handwheel: Malleable iron, bronze, or aluminum.
- B. Bronze Gate Valves, RS, Class 150:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.
    - b. Hammond Valve.
    - c. KITZ Corporation.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Powell Valves.
    - g. Stockham; Crane Energy Flow Solutions.
    - h. Watts; a Watts Water Technologies company.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 2.
    - b. CWP Rating: 300 psig.
    - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
    - d. Ends: Threaded.
    - e. Stem: Bronze.
    - f. Disc: Solid wedge; bronze.
    - g. Packing: Asbestos free.
    - h. Handwheel: Malleable iron [, bronze, or aluminum].

## 2.03 IRON GATE VALVES

- A. Iron Gate Valves, OS&Y, Class 125:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane; Crane Energy Flow Solutions.



- b. Flo Fab Inc.
  - c. Hammond Valve.
  - d. Jenkins Valves; Crane Energy Flow Solutions.
  - e. KITZ Corporation.
  - f. Legend Valve & Fitting, Inc.
  - g. Milwaukee Valve Company.
  - h. NIBCO INC.
  - i. Powell Valves.
  - j. Stockham; Crane Energy Flow Solutions.
  - k. Watts; a Watts Water Technologies company.
2. Description:
- a. Standard: MSS SP-70, Type I.
  - b. NPS 2 ½ -inch to NPS 12-inch, CWP Rating: 200 psig.
  - c. NPS 14-inch to NPS 24-inch, CWP Rating: 150 psig.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged.
  - f. Trim: Bronze.
  - g. Disc: Solid wedge.
  - h. Packing and Gasket: Asbestos free.

#### 2.04 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Babbitt Steam Specialty Co.
  - 2. Roto Hammer Industries.
  - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to hand wheels.
- 1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc or epoxy coating.
  - 2. Chain: Hot-dip-galvanized steel, of size required to fit sprocket rim.

### PART 3 - EXECUTION

#### 3.01 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for gate valves NPS 4-inch and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

### 3.02 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Gate valves.
- B. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, NPS 2-inch and Smaller: Threaded ends, except where solder-joint valve-end option is indicated in valve schedules below.
  - 2. For Copper Tubing, NPS 2 ½ -inch to NPS 4-inch: Flanged ends, except where threaded valve-end option is indicated in valve schedules below.
  - 3. For Copper Tubing, NPS 5-inch and Larger: Flanged ends.
  - 4. For Steel Piping, NPS 2-inch and Smaller: Threaded ends.
  - 5. For Steel Piping, NPS 2 ½ -inch to NPS 4-inch: Flanged ends, except where threaded valve-end option is indicated in valve schedules below.
  - 6. For Steel Piping, NPS 5-inch and Larger: Flanged ends.

### 3.04 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

- A. Pipe NPS 2-inch and Smaller: Bronze gate valves, RS, Class 125.
- B. Pipe NPS 2 ½ -inch and Larger: Iron gate valves, OS&Y, Class 125.

### 3.05 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG).

- A. Pipe NPS 2-inch and Smaller: Bronze gate valves, RS, Class 125.
- B. Pipe NPS 2 ½ -inch and Larger: Iron gate valves, OS&Y, Class 125.

### 3.06 STEAM-CONDENSATE VALVE SCHEDULE

- A. Pipe NPS 2-inch and Smaller: Bronze gate valves, RS, Class 125.
- B. Pipe NPS 2 ½ -inch and Larger: Iron gate valves, OS&Y, Class 125.

END OF SECTION

## **SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
1. Metal pipe hangers and supports.
  2. Trapeze pipe hangers.
  3. Thermal-hanger shield inserts.
  4. Fastener systems.
  5. Equipment supports.

#### **1.02 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
  2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

#### **1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following: include Product Data for components:
1. Trapeze pipe hangers.
  2. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### **1.04 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

#### **1.05 QUALITY ASSURANCE**

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## **PART 2 - PRODUCTS**

### **2.01 METAL PIPE HANGERS AND SUPPORTS**

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
- D. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

### **2.02 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop or field fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### **2.03 THERMAL-HANGER SHIELD INSERTS**

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.04 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert wedge type, stainless steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.05 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.06 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

# PART 3 - EXECUTION

## 3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2-inch and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
  1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4-inch and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4-inch and larger if pipe is installed on rollers.
  4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS ¼-inch to NPS 2 ½ -inch: 12 inches long and 0.048 inch thick.
    - b. NPS 4-inch: 12 inches long and 0.06 inch thick.
    - c. NPS 5-inch and NPS 6-inch: 18 inches long and 0.06 inch thick.
    - d. NPS 8-inch to NPS 14-inch: 24 inches long and 0.075 inch thick.
    - e. NPS 16-inch to NPS 24-inch: 24 inches long and 0.105 inch thick.
  5. Pipes NPS 8-inch and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.02 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support

equipment above floor.

- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.03 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.04 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous thread hanger and support rods to 1 ½ inches.

### 3.05 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 a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.06 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications. Use aluminum pipe hangers and aluminum attachments for Natatorium environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2-inch to NPS 30-inch.
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg. F, pipes NPS 4-inch to NPS 24-inch, requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4-inch to NPS 36-inch, requiring clamp flexibility and up to 4 inches of insulation.
  4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2-inch to NPS 8-inch.
  5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2-inch to NPS 30-inch.
  6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4-inch to NPS 36-inch, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4-inch to NPS 36-inch, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1-inch to NPS 30-inch, from two rods if longitudinal movement caused by expansion and contraction might occur.
  9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2-inch to NPS 42-inch if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4-inch to NPS 24-inch.
  2. Carbon or Alloy Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4-inch to NPS 24-inch if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg. F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to



- suspend pipe hangers from concrete ceiling.
  - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  - 6. C-Clamps (MSS Type 23): For structural shapes.
  - 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  - 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  - 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1 ¼ inches.
  - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

## SECTION 23 05 48.13 - VIBRATION CONTROLS FOR HVAC

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
1. Elastomeric isolation pads.
  2. Elastomeric isolation mounts.
  3. Restrained elastomeric isolation mounts.
  4. Open-spring isolators.
  5. Housed-spring isolators.
  6. Restrained-spring isolators.
  7. Housed-restrained-spring isolators.
  8. Pipe-riser resilient supports.
  9. Resilient pipe guides.
  10. Elastomeric hangers.
  11. Spring hangers.

#### 1.02 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.01 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Kinetics Noise Control, Inc.
    - b. Mason Industries, Inc.
  2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  3. Size: Factory or field cut to match requirements of supported equipment.
  4. Pad Material: Oil and water resistant with elastomeric properties.
  5. Surface Pattern: Waffle pattern.
  6. Infused nonwoven cotton or synthetic fibers.
  7. Load-bearing metal plates adhered to pads.
  8. Application: Floor mounted furnaces and A/C units of 2000 CFM or less. Roof mounted condensing units up to 5 tons shall be mounted on curbs with neoprene pads. See spring mounts for over 5 tons.

## 2.02 ELASTOMERIC ISOLATION MOUNTS

### A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Kinetics Noise Control, Inc.
  - b. Mason Industries, Inc.
2. Mounting Plates:
  - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
  - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.
4. Application: Base mounted pumps up to 5 Hp slab on grade, air handling units' slab on grade.

## 2.03 OPEN SPRING ISOLATORS

### A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Kinetics Noise Control, Inc.
  - b. Mason Industries, Inc.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
8. Application: Base mounted pumps not slab on grade and less than 5 Hp, base mounted pumps slab on grade 7 ½ HP and up. Air handling units not slab on grade. Roof mounted condensing units over 5 tons cooling capacity.

## 2.04 RESTRAINED SPRING ISOLATORS

### A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Kinetics Noise Control, Inc.
  - b. Mason Industries, Inc.
2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

- a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
- b. Top plate with elastomeric pad.
- c. Internal leveling bolt that acts as blocking during installation.
3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Application: Steam-Hot water heat exchangers.

## 2.05 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

## 2.06 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## 2.07 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Kinetics Noise Control, Inc.
    - b. Mason Industries, Inc.
  2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-

- reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
  9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
  10. Application: Below 5 ton horizontal suspended heat pumps and fan/coil units, in-line exhaust fans.

## 2.08 PRE-COMPRESSED SPRING AND NEOPRENE HANGERS

- A. Vibration hangers shall be spring and neoprene as described above, but they shall be pre-compressed to the rated deflection so as to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale.
- B. Hangers shall be type PC30N as manufactured by Mason Industries, Inc. or equivalent by Vibration Eliminator Company or Amber Booth.
- C. Application: Horizontal fan/coil units above 5 ton capacity.

## 2.09 DUCT HANGERS

- A. Vibration hangers shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent a short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Hangers shall be provided with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps. Submittals shall include a scale drawing of the hanger showing the 30 degree capability.
- B. Hangers shall be type W30 as manufactured by Mason Industries, Inc. or equivalent by Vibration Eliminator Company or Amber Booth.
- C. Application: Ductwork in mechanical rooms below occupied spaces.

## 2.10 EQUIPMENT FRAME BASES

- A. Vibration isolator manufacturer shall furnish integral structural steel bases. Bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases which may be "T" or "L" shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of one inch.
- B. Bases shall be type WF as manufactured by Mason Industries, Inc. or equivalent by Vibration Eliminator Company or Amber Booth.
- C. Application: Special use where structural rigidity required between components.

## 2.11 EQUIPMENT RAIL BASES

- A. Vibration isolator manufacturer shall provide steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary rigid to prevent strains in the equipment.
- B. Inverted saddles shall be type ICS as manufactured by Mason Industries, Inc. or equivalent by Vibration Eliminator Company or Amber Booth.
- C. Application: Base mounted HVAC units.

## 2.12 FLOATING CONCRETE BASES

- A. Vibration isolator manufacturer shall furnish rectangular structural beam or channel concrete forms for floating foundations. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. In general, bases shall be a minimum of 1/12th of the longest dimension of the base, but not less than 6". Forms shall include minimum concrete reinforcement consisting of half-inch bars or angles welded in palace on 6" centers running both ways in a layer 1 1/2" above the bottom, or additional steel as is required by the structural conditions. Forms shall be furnished with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts where the anchor bolts fall in concrete locations. Height saving brackets shall be employed in all mounting locations. Height saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base.
- B. Bases shall be type K as manufactured by Mason Industries, Inc. or equivalent by Vibration Eliminator Company or Amber Booth.
- C. Application: Centrifugal pumps over 5 Hp and not slab on grade.

## 2.13 ROOF CURB BASES

- A. Curb mounted rooftop equipment shall be mounted on vibration isolation bases that fit over the roof curb and under the isolated equipment. The extruded aluminum top members shall overlap the bottom member to provide water runoff independent of the seal. The aluminum member shall house cadmium plated springs having a 1 inch, 2 inch minimum deflection with 50% addition travel to solid. Spring diameters shall be no less than 0.8 of the spring height at rated load. Wind resistance shall be provided by means of resilient snubbers in the corners with a minimum clearance of 1/4" so as not to interfere with the spring action except in high winds. The weather seal shall consist of continuous closed cell sponge materials both above and below the base and a waterproof flexible duct like connection joining the outside perimeter of the aluminum members. Foam or other contact like seals are unacceptable at the spring cavity closure. Caulking shall be kept to a minimum.
- A. HUSHCORE Base System Model HIR-2. Curb mounted rooftop equipment shall be mounted on vibration isolation bases that fit over the roof curb and under the isolated equipment. The structural isolation rail curbs shall bear directly on the RTU factory curb which must be flashed and waterproofed into the roof's membrane waterproofing system. The installation shall be capable of being re-flashed without lifting the unit. Equipment manufacturer's base factory curbs shall be coordinated with the HIR rail curbs. Curb rail sides and ends shall be manufactured from minimum 14 ga. G90 galvanized sheet metal (expanded metal or painted steel is not acceptable), reinforced and cross braced as required. All springs shall provide a

minimum of 85% vibration isolation efficiency. All springs shall be adjustable for leveling. Spring assemblies shall contain restraints and snubbers to resist wind and seismic forces. Seismic performance criteria shall be as shown or indicated on the drawings, schedules or in the vibration control specification. The factory curb shall accept standard 2” roof insulation supplied and installed by the roofing contractor. A resilient weather seal shall be incorporated into the rail curb design between the isolated top frame and the base curb assembly. Wood nailer and flashing shall be provided and rail curbs shall be manufactured to NRCA standards. Curb rail height shall be 13 ½” high minimum in addition to the base factory curb height or as shown on the drawings. Curbs shall be shipped pre-assembled. Knocked down kits are not acceptable. All non-galvanized materials shall be prime paint finished. All duct supports, bracing, flashing and safing as required. Unless otherwise recommended by the RTU manufacturer, all curbs shall be full perimeter type.

- B. HUSHCORE® DECK™ System In-Curb Multi-Layer Acoustical Treatment
  - 1. HUSHCORE® DECK™ system shall be multiple layers installed to meet the following acoustical performance. Materials shall meet Class “A” for flammability as per ASTM E-84 test procedures.

HUSHCORE In-Curb Composite - (Transmission Loss) in accordance with ASTM E-90-10																						
Freq. (Hz)	80	100	125	160	200	250	315	400	500	630	800	1K	1.25K	1.6K	2K	2.5K	3.15K	4K	5K	6.3K	8K	STC
Transmission Loss (dB)	18	23	34	36	43	45	51	55	57	60	60	62	64	67	66	66	71	74	76	78	81	57

- 2. Decking shall be maintained inside the curb to a clearance of ¼” maximum around all duct drops but may never contact the duct.
- 3. Total thickness shall not exceed 10” for all in-curb layers.
- 4. HUSH SEALANT™ HSAC-100 shall be used in the following areas.
  - a. Around the entire curb interior perimeter
  - b. Around duct drop penetrations of the decking
  - c. Sealant shall be an acoustical grade, non-hardening formulation.
- C. Curb mounted bases shall be type CMAB as manufactured by Mason Industries or equivalent by Vibration Eliminator Company, Amber Booth, Thi-Curb, Custom Curb or R.P.S.
- D. Application: Roof mounted A/C units, air handling units and separated condensing units.

**PART 3 - EXECUTION**

3.01 VIBRATION CONTROL DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Architectural specification sections.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Select the appropriate base to match the equipment being provided. Base shall meet the

exact dimensional and weight requirements at all points of the curb. Install as recommended by the vibration isolator manufacturer.

END OF SECTION



## SECTION 23 05 50 - FIRE STOPPING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Refer to Section 23 05 00 for requirements which are applicable to this section.
- B. Refer to International Building Codes.
- C. Section includes.
  - 1. Through penetration firestops and smoke-stops for all fire rated bearing and non-bearing wall and floor assemblies, both blank (empty) and those accommodating penetrating items such as cables, conduits, pipes, ducts, etc.

#### 1.02 REFERENCES

- A. American Society for Testing and Materials Standards (ASTM):
  - 1. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 2. ASTM E814: Standard Test method for Fire Tests of Through-Penetration Firestops.
- B. Underwriters Laboratories, Inc.:
  - 1. UL 723 Surface Burning Characteristics of Building Materials
  - 2. UL 1479 Fire Tests of Through-Penetration Firestops.
- C. UL Fire Resistance Directory:
  - 1. Through Penetration Firestop Devices (XHJI)
  - 2. Fire Resistive Ratings (BXUV)
  - 3. Through Penetration Firestop Systems (XHEZ)
  - 4. Fill, Void, or Cavity Material (XHHW)

#### 1.03 DEFINITIONS

- A. FIRESTOPPING: The use of a material or combination of materials in a fire rated structure (wall or floor) where it has been breached, so as to restore the integrity of the fire rating on that wall or floor.
- B. SYSTEM: The use of a specific firestop material or combination of materials in conjunction with a specific wall or floor construction type and a specific penetrant(s), constitutes a "System."
- C. BARRIER: Any bearing or non-bearing wall or floor that has an hourly fire and smoke rating.
- D. THROUGH-PENETRATION: Any penetration of a fire rated wall or floor that completely breaches the barrier.
- E. MEMBRANE-PENETRATION: Any penetration in a fire rated wall that breaches only one side of the barrier.
- F. CONSTRUCTION GAPS: any gap, joint, or opening, whether static or dynamic, where the top of a wall may meet a floor; wall to wall applications; edge to edge floor configurations; floor to exterior wall; or any linear breach in a rated barrier. Where movement is required, the firestopping system must comply with UL2079 for dynamic joints.

#### 1.04 SUBMITTALS

NOTE: A “Certificate of Conformance,” from the manufacturers listed in Section “2.02 Acceptable Manufacturers,” is required with the “Submittal Package” to ensure that the material selected meets all of the criteria of this specification as set forth in Section “1.05 Quality Assurance.”

- A. Submit manufacturer’s product literature for each type of firestop material to be installed. Literature shall indicate product characteristics, typical uses, performance and imitation criteria, and test data. Submittal should be in compliance with Section 23 05 00.
- B. Material Safety Data Sheets (MSDS): Submit MSDS for each firestop product.
- C. UL Tested Systems: Submit drawings showing typical installation details for the methods of installation. Indicate which firestop materials will be used and thickness for different hourly ratings.
- D. Engineering Judgments: Submit manufacturer’s drawings for all non-standard applications where no UL rested system exists. All drawings must indicate the “Tested” UL system upon which the judgment is based so as to assess the relevance of the judgment to some known performance.
- E. Submit manufacturer’s installation procedures for each type of product.
- F. Approved Applicator: Submit document from manufacturer wherein manufacturer recognizes the installer as qualified or submit a list of past projects to demonstrate capability to perform intended work.
- G. Upon completion, installer shall provide written certification that materials were installed in accordance with the manufacturer’s installation instructions and details.

#### 1.05 QUALITY ASSURANCE

- A. Firestopping systems (materials and design):
  - 1. Shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests in a configuration that is representative of field conditions.
  - 2. The F rating must be minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column joints, must be tested to UL 2079 with movement capabilities equal to those of the anticipated conditions.
- B. Firestopping materials and systems must be capable of closing or filling through openings created by 1) the burning or melting of combustible pipes, cable jacketing, or pipe insulation materials, or 2) deflection of sheet metal due to thermal expansion (electrical & mechanical duct work).
- C. Firestopping material shall be asbestos and lead free and shall not incorporate nor require the use of hazardous solvents.
- D. Firestopping sealants must be flexible, allowing for normal pipe movement.
- E. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.
- F. Firestopping materials shall be moisture resistant and may not dissolve in water after curing.

- G. All firestopping materials shall be manufactured by one manufacturer (to the maximum extent possible).
- H. Installation of firestopping systems shall be performed by a contractor (or contractors) trained or approved by the firestop manufacturer.
- I. Material used shall be in accordance with the manufacturer's written installation instructions.

#### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver material in the manufacturer's original, unopened containers or packages with the manufacturer's name, product identification, lot number, UL label and mixing and installation instructions as applicable.
- B. Store materials in the original, unopened containers or packages and under conditions recommended by the manufacturer.
- C. All firestop materials will be installed prior to expiration of shelf life.

#### 1.07 PROJECT CONDITIONS

- A. Conform to manufacturer's printed instructions for installation and when applicable, curing in accordance with temperature and humidity. Conform to ventilation and safety requirements.
- B. Verify the condition of the substrates before starting work.
- C. Weather Conditions: Do not proceed with installation of firestop materials when temperatures fall outside the manufacturer's suggested limits.
- D. Care should be taken to ensure that firestopping materials are installed so as not to contaminate adjacent surfaces.

#### 1.08 SEQUENCING

- A. Schedule firestopping after installation of penetrants but prior to concealing the openings.
- B. Firestopping shall precede gypsum board finishing.

#### 1.09 PROTECTION

- A. Where firestopping is installed at locations which will remain exposed in the completed work, provide protection as necessary to prevent damage to adjacent surfaces and finishes, and protect as necessary against damage from other construction activities.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Firestopping materials and systems shall meet the requirements specified herein.
- B. Architect must approve in writing any alternates to the materials and system specified herein.
- C. All firestop products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the thermal and fire resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.

- D. For applications where combustible penetrants are involved, i.e., insulated, and plastic pipe, a suitable intumescent material must be used.

## 2.02 ACCEPTABLE MANUFACTURERS

NOTE: Inclusion of materials in this specification does not indicate that the listed products have been evaluated for conformance to this specification. Therefore, the user/contractor must certify in the submittal package, with a "Certificate of Conformance" from the manufacturers listed below, that the material selected meets all of the criteria set forth in Section "1.05 Quality Assurance" of this specification.

- A. Specified Technologies, Inc./GE Pensil® (STI), Somerville, NJ 08876, Phone: (800) 992-1180.  
B. 3M Fire Protection Products, St. Paul, MN

## 2.03 MATERIALS

- A. Intumescent Firestop Sealants and Caulks:  
1. STI SpecSeal SSS100  
2. 3M Fire Barrier Caulk CP25WB+
- B. Latex Firestop Sealant  
1. STI SpecSeal LC150 Sealant
- C. Elastomeric Water-Based Sealant  
1. STI SpecSeal ES100 Elastomeric Sealant
- D. Silicone Firestop Sealants and Caulks:  
1. STI SpecSeal Pensil 300\  
2. 3M Fire Barrier Silicone Sealants
- E. Firestop Putty:  
1. STI SpecSeal Firestop Putty Bars and Pads  
2. 3M Fire Barrier Moldable Putty
- F. Firestop Collars:  
1. STI Spec Seal Firestop Collars  
2. 3M Fire Barrier PPD's.
- G. Wrap Strips:  
1. SpecSeal Wrap Strip  
2. 3M Fire Barrier FS195 Wrap Strip.
- H. 2-Part Silicone Firestop Foam:  
1. STI SpecSeal Pensil 200  
2. 3M Fire Barrier 2001 Silicone Foam.
- I. Firestop Mortar:  
1. STI SpecSeal Mortar.
- J. Firestop Pillows:  
1. STI SpecSeal Pillows
- K. Elastomeric Spray:  
1. STI SpecSeal AS Elastomeric Spray
- L. Composite Board:

- 1. 3M Barrier Sheet Material
- M. Accessories:
- 2.04 Forming/Damming Materials: Mineral fiberboard or other type as per manufacturer recommendation.

### **PART 3 - CONDITIONS REQUIRING FIRESTOPPING**

- A. General:
  - B. Provide firestopping for conditions specified whether or not firestopping is indicated, and if indicated, whether such material is designed as insulation, safing, or otherwise.
  - C. Through-Penetrations:
  - D. Firestopping shall be installed in all open penetrations and in the annular space in all penetrations in any bearing or non-bearing fire-rated barrier.
  - E. Membrane-Penetrations:
  - F. Where required by code, all membrane-penetrations in rated walls shall be protected with firestopping products that meet the requirements of third party time/temperature testing.
  - G. Construction Joints/Gaps:
  - H. Fire Stopping shall be provided:
    - 1. Between the edges of floor slabs and exterior walls.
    - 2. Between the tops of walls and the underside of floors
    - 3. In the control joint in masonry walls and floors
    - 4. In expansion joints.
  - I. Smoke-Stopping:
- 3.02 As required by the other Sections, Smoke-Stops shall be provided for Through-Penetrations, Membrane-) Penetrations, and Construction Gaps with a material approved and tested for such application.
- 3.03 EXAMINATION
- A. Examine the areas and conditions where firestops are to be installed and notify the architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable to the architect and in accordance with Section 01039.
  - B. Verify that environmental conditions are safe and suitable for installation of firestop products.
  - C. Verify that all pipe, conduit, cable, and other items which penetrate fire-rated construction have been permanently installed prior to installation of firestops.
- 3.04 INSTALLATION
- A. General:
    - 1. Installation of firestops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.

2. Apply firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
  3. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.
  4. Seal holes and penetrations to ensure an effective smoke seal.
  5. In areas of high traffic, protect firestopping materials from damage. If the opening is large, install firestopping materials capable of supporting the weight of a human.
  6. Insulation types specified in other sections shall not be installed in lieu of firestopping material specified herein.
  7. All combustible penetrants (e.g., Non-metallic pipes or insulated metallic pipes) shall be fire stopped using products and systems tested in a configuration representative of the field condition.
- B. Dam Construction: When required to properly contain firestopping materials within openings damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Non-combustible damming materials may be left as a permanent component of the firestop system.

### 3.05 FIELD QUALITY CONTROL

- A. Prepare and install firestopping systems in accordance with manufacturer's printed instructions and recommendations.
- B. Follow safety procedures recommended in the Material Safety Data Sheets.
- C. Finish surfaces of firestopping which are to remain exposed in the completed work to a uniform and level condition.
- D. All areas of work must be accessible until inspection by the applicable Code Authorities.
- E. Correct unacceptable firestops and provide additional inspection to verify compliance with this specification.

### 3.06 CLEANING

- A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.
- B. Leave finished work in neat, clean condition with no evidence of spill overs or damage to adjacent surfaces.

END OF SECTION

## **SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Equipment labels.
  2. Warning signs and labels.
  3. Pipe labels.
  4. Duct labels.

#### 1.02 ACTION SUBMITTALS

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

### **PART 2 - PRODUCTS**

#### 2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Brimar Industries, Inc.
    - c. Carlton Industries, LP.
    - d. Champion America.
    - e. Craftmark Pipe Markers.
    - f. emedco.
    - g. Kolbi Pipe Marker Co.
    - h. LEM Products Inc.
    - i. Marking Services, Inc.
    - j. Seton Identification Products.
  2. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  3. Letter Color: Black.
  4. Background Color: White.
  5. Minimum Label Size: Length and width vary for required label content, but not less than 2 ½ by ¾ inch.
  6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-

- quarters the size of principal lettering.
- 7. Fasteners: Stainless-steel self-tapping screws.
- 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Brimar Industries, Inc.
    - c. Carlton Industries, LP.
    - d. Champion America.
    - e. Craftmark Pipe Markers.
    - f. emedco.
    - g. Kolbi Pipe Marker Co.
    - h. LEM Products Inc.
    - i. Marking Services, Inc.
    - j. Seton Identification Products.
  - 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  - 3. Letter Color: Black.
  - 4. Background Color: White.
  - 5. Maximum Temperature: Able to withstand temperatures up to 160 deg. F.
  - 6. Minimum Label Size: Length and width vary for required label content, but not less than 2 ½ by ¾ inch.
  - 7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  - 8. Fasteners: Stainless-steel self-tapping screws.
  - 9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8 ½ by 11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.02 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Brimar Industries, Inc.
  - 3. Carlton Industries, LP.
  - 4. Champion America.



5. Craftmark Pipe Markers.
  6. emedco.
  7. LEM Products Inc.
  8. Marking Services Inc.
  9. National Marker Company.
  10. Seton Identification Products.
  11. Stranco, Inc.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: White
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg. F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2 ½ by ¾ inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

### 2.03 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
  2. Brady Corporation.
  3. Brimar Industries, Inc.
  4. Carlton Industries, LP.
  5. Champion America.
  6. Craftmark Pipe Markers.
  7. emedco.
  8. Kolbi Pipe Marker Co.
  9. LEM Products Inc.
  10. Marking Services Inc.
  11. Seton Identification Products.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: Size letters according to ASME A13.1 for piping. At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

#### 2.04 DUCT LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Brady Corporation.
  2. Brimar Industries, Inc.
  3. Carlton Industries, LP.
  4. Champion America.
  5. Craftmark Pipe Markers.
  6. emedco.
  7. Kolbi Pipe Marker Co.
  8. LEM Products Inc.
  9. Marking Services Inc.
  10. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: White.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg. F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2 ½ by ¾ inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
  1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.02 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.03 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet areas of congested piping and equipment.
- C. Pipe Label Color Schedule:
  - 1. Chilled-Water Piping: White letters on a safety-green background.
  - 2. Heating Water Piping: White letters on a safety-green background.
  - 3. Refrigerant Piping: Black letters on a safety-orange background.
  - 4. Low-Pressure Steam Piping: White letters on a safety-purple background.
  - 5. High-Pressure Steam Piping: White letters on a safety-purple background.
  - 6. Steam Condensate Piping: White letters on a safety-purple background.

### 3.04 DUCT LABEL INSTALLATION

- A. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue: For cold-air supply ducts.
  - 2. Yellow: For hot-air supply ducts.
  - 3. Green: For exhaust, outside, relief, return, and mixed-air ducts.
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION

## **SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
  - 2. Balancing Hydronic Piping Systems:
    - a. Constant-flow hydronic systems.
    - b. Variable-flow hydronic systems.

#### 1.02 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Certified TAB reports.

#### 1.04 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC or NEBB.
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB as a TAB technician.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

### **PART 2 - EXECUTION**

## 2.01 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

## 2.02 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures for balancing the systems.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system

readiness for TAB work. Include, at a minimum, the following:

1. Airside:
  - a. Duct systems are complete with terminals installed.
  - b. Volume, smoke, and fire dampers are open and functional.
  - c. Clean filters are installed.
  - d. Fans are operating, free of vibration, and rotating in correct direction.
  - e. Variable-frequency controllers' startup is complete, and safeties are verified.
  - f. Automatic temperature-control systems are operational.
  - g. Ceilings are installed.
  - h. Windows and doors are installed.
  - i. Suitable access to balancing devices and equipment is provided.
2. Hydronics:
  - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
  - b. Piping is complete with terminals installed.
  - c. Water treatment is complete.
  - d. Systems are flushed, filled, and air purged.
  - e. Strainers are pulled and cleaned.
  - f. Control valves are functioning per the sequence of operation.
  - g. Shutoff and balance valves have been verified to be 100 percent open.
  - h. Pumps are started, and proper rotation is verified.
  - i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
  - j. Variable-frequency controllers' startup is complete and safeties are verified.
  - k. Suitable access to balancing devices and equipment is provided.

## 2.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
  3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

## 2.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."
- M. The contractor shall allow for (2) passes for each heating and cooling season.
- N. Allow for one sheave change for 50% of the HVAC systems to be tested and adjusted. Replacement sheave shall be furnished and installed by the mechanical contractor. Sheave shall be adjusted by the TBA contractor.

## 2.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
  - 2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  - 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 4. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-

- handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
  2. Adjust submain and branch duct volume dampers for specified airflow.
  3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  2. Measure inlets and outlets airflow.
  3. Adjust each inlet and outlet for specified airflow.
  4. Re-measure each inlet and outlet after they have been adjusted.

## 2.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Adjust the variable-air-volume systems as follows:
1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
  2. Verify that the system is under static pressure control.
  3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
    - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    - d. Adjust controls so that terminal is calling for minimum airflow.
    - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    - f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
    - g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.



5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
  - a. Set outside air, return air, and relief air dampers for proper position that simulates minimum outdoor-air conditions.
  - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
  - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
  - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
6. Measure fan static pressures as follows:
  - a. Measure static pressure directly at the fan outlet or through the flexible connection.
  - b. Measure static pressure directly at the fan inlet or through the flexible connection.
  - c. Measure static pressure across each component that makes up the air-handling system.
  - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
  - a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
  - b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:
  - a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
  - b. Re-measure and confirm that total airflow is within design.
  - c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
  - d. Mark final settings.
  - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
  - f. Verify tracking between supply and return fans.

## 2.07 DUCTWORK LEAKAGE TESTING

- A. Installed ductwork shall be tested prior to installation of access doors, take-offs, etc.
- B. All leak testing shall be witnessed by the engineer or representative of the engineer. The contractor shall give the engineer 72 hours' notice prior to testing. Any testing not witnessed by the engineer or his/her representative shall be considered invalid and will be redone.

- C. The testing shall be performed as follows:
1. Perform testing in accordance with HVAC Air Duct Leakage Test Manual.
  2. Use a certified orifice tube for measuring the leakage.
  3. Determine section of system to be tested and blank off.
  4. Determine the percentage of the system being tested.
  5. Using that percentage, determine the allowable leakage (cfm) for that section being tested.
  6. Pressurize to operating pressure and repair any significant or audible leaks.
  7. Re-pressurize the measure leakage.
  8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in step 5.

NOTE: It is recommended that the first 100'-300' of ductwork installed be tested to insure the quality of the workmanship at an early stage.

## 2.08 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
1. Check liquid level in expansion tank.
  2. Check highest vent for adequate pressure.
  3. Check flow-control valves for proper position.
  4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
  5. Verify that motor starters are equipped with properly sized thermal protection.
  6. Check that air has been purged from the system.
- D. The contractor shall allow for (2) passes for each system and each terminal unit.

## 2.09 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Adjust pumps to deliver total design gpm.
1. Measure total water flow.
    - a. Position valves for full flow through coils.
    - b. Measure flow by main flow meter, if installed.
    - c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
  2. Measure pump TDH as follows:
    - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    - c. Convert pressure to head and correct for differences in gage heights.
    - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

- e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
- B. Adjust flow-measuring devices installed in mains and branches to design water flows.
  1. Measure flow in main and branch pipes.
  2. Adjust main and branch balance valves for design flow.
  3. Re-measure each main and branch after all have been adjusted.
- C. Adjust flow-measuring devices installed at terminals for each space to design water flows.
  1. Measure flow at terminals.
  2. Adjust each terminal to design flow.
  3. Re-measure each terminal after it is adjusted.
  4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
  5. Perform temperature tests after flows have been balanced.
- D. For systems with pressure-independent valves at terminals:
  1. Measure differential pressure and verify that it is within manufacturer's specified range.
  2. Perform temperature tests after flows have been verified.
- E. For systems without pressure-independent valves or flow-measuring devices at terminals:
  1. Measure and balance coils by either coil pressure drop or temperature method.
  2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
- F. Verify final system conditions as follows:
  1. Re-measure and confirm that total water flow is within design.
  2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
  3. Mark final settings.
- G. Verify that memory stops have been set.

## 2.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.
- B. Adjust the variable-flow hydronic system as follows:
  1. Verify that the differential-pressure sensor is located as indicated.
  2. Determine whether there is diversity in the system.
- C. For systems with no diversity:
  1. Adjust pumps to deliver total design gpm.
    - a. Measure total water flow.
  2. Position valves for full flow through coils.
  3. Measure flow by main flow meter, if installed.
  4. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
    - a. Measure pump TDH as follows:
      - 1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      - 2) Measure inlet pressure directly at the pump inlet flange or in suction

- pipe prior to any valves or strainers.
- 3) Convert pressure to head and correct for differences in gage heights.
  - 4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
  - 5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
- b. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
5. Adjust flow measuring devices installed in mains and branches to design water flows.
    - a. Measure flow in main and branch pipes.
    - b. Adjust main and branch balance valves for design flow.
    - c. Re-measure each main and branch after all have been adjusted.
  6. Adjust flow-measuring devices installed at terminals for each space to design water flows.
    - a. Measure flow at terminals.
    - b. Adjust each terminal to design flow.
    - c. Re-measure each terminal after it is adjusted.
    - d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
    - e. Perform temperature tests after flows have been balanced.
  7. For systems with pressure-independent valves at terminals:
    - a. Measure differential pressure and verify that it is within manufacturer's specified range.
    - b. Perform temperature tests after flows have been verified.
  8. For systems without pressure-independent valves or flow-measuring devices at terminals:
    - a. Measure and balance coils by either coil pressure drop or temperature method.
    - b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
  9. Prior to verifying final system conditions, determine the system differential-pressure set point.
  10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
  11. Mark final settings and verify that all memory stops have been set.
  12. Verify final system conditions as follows:
    - a. Re-measure and confirm that total water flow is within design.
    - b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
    - c. Mark final settings.
  13. Verify that memory stops have been set.
- D. For systems with diversity:
1. Determine diversity factor.
  2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
  3. Adjust pumps to deliver total design gpm.

- a. Measure total water flow.
    - 1) Position valves for full flow through coils.
    - 2) Measure flow by main flow meter, if installed.
    - 3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
  - b. Measure pump TDH as follows:
    - 1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    - 2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    - 3) Convert pressure to head and correct for differences in gage heights.
    - 4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    - 5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
  - c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
4. Adjust flow-measuring devices installed in mains and branches to design water flows.
    - a. Measure flow in main and branch pipes.
    - b. Adjust main and branch balance valves for design flow.
    - c. Re-measure each main and branch after all have been adjusted.
  5. Adjust flow-measuring devices installed at terminals for each space to design water flows.
    - a. Measure flow at terminals.
    - b. Adjust each terminal to design flow.
    - c. Re-measure each terminal after it is adjusted.
    - d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
    - e. Perform temperature tests after flows have been balanced.
  6. For systems with pressure-independent valves at terminals:
    - a. Measure differential pressure and verify that it is within manufacturer's specified range.
    - b. Perform temperature tests after flows have been verified.
  7. For systems without pressure-independent valves or flow-measuring devices at terminals:
    - a. Measure and balance coils by either coil pressure drop or temperature method.
    - b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
  8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
  9. Prior to verifying final system conditions, determine system differential-pressure set point.
  10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record

- pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
  12. Verify final system conditions as follows:
    - a. Re-measure and confirm that total water flow is within design.
    - b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
    - c. Mark final settings.
  13. Verify that memory stops have been set.

## 2.11 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
  2. Air Outlets and Inlets: Plus or minus 10 percent.
  3. Heating-Water Flow Rate: Plus or minus 10 percent.
  4. Cooling-Water Flow Rate: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

## 2.12 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
  3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  1. Pump curves.
  2. Fan curves.
  3. Manufacturers' test data.
  4. Field test reports prepared by system and equipment installers.
  5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  1. Title page.
  2. Name and address of the TAB specialist.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.

- b. Notable characteristics of systems.
      - c. Description of system operation sequence if it varies from the Contract Documents.
    - 12. Nomenclature sheets for each item of equipment.
    - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
    - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
    - 15. Test conditions for fans and pump performance forms including the following:
      - a. Settings for outdoor-, return-, and exhaust-air dampers.
      - b. Conditions of filters.
      - c. Cooling coil, wet- and dry-bulb conditions.
      - d. Face and bypass damper settings at coils.
      - e. Fan drive settings including settings and percentage of maximum pitch diameter.
      - f. Inlet vane settings for variable-air-volume systems.
      - g. Settings for supply-air, static-pressure controller.
      - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
  - 1. Quantities of outdoor, supply, return, and exhaust airflows.
  - 2. Water and steam flow rates.
  - 3. Duct, outlet, and inlet sizes.
  - 4. Pipe and valve sizes and locations.
  - 5. Terminal units.
  - 6. Balancing stations.
  - 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
  - 1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    - j. Number, make, and size of belts.
    - k. Number, type, and size of filters.
  - 2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.

- b. Total system static pressure in inches wg.
  - c. Fan rpm.
  - d. Discharge static pressure in inches wg.
  - e. Filter static-pressure differential in inches wg.
  - f. Preheat-coil static-pressure differential in inches wg.
  - g. Cooling-coil static-pressure differential in inches wg.
  - h. Heating-coil static-pressure differential in inches wg.
  - i. Outdoor airflow in cfm.
  - j. Return airflow in cfm.
  - k. Outdoor-air damper position.
  - l. Return-air damper position.
  - m. Vortex damper position.
- F. Air-Terminal-Device Reports:
- 1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Apparatus used for test.
    - d. Area served.
    - e. Make.
    - f. Number from system diagram.
    - g. Type and model number.
    - h. Size.
    - i. Effective area in sq. ft.
  - 2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary airflow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final airflow rate in cfm.
    - f. Final velocity in fpm.
    - g. Space temperature in deg. F.
- G. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
- 1. Unit Data:
    - a. System and air-handling-unit identification.
    - b. Location and zone.
    - c. Room or riser served.
    - d. Coil make and size.
    - e. Flowmeter type.
  - 2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Entering-water temperature in deg. F.
    - c. Leaving-water temperature in deg. F.
    - d. Water pressure drop in feet of head or psig.
    - e. Entering-air temperature in deg. F.
    - f. Leaving-air temperature in deg. F.
- H. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
- 1. Unit Data:



- a. Unit identification.
  - b. Location.
  - c. Service.
  - d. Make and size.
  - e. Model number and serial number.
  - f. Water flow rate in gpm.
  - g. Water pressure differential in feet of head or psig.
  - h. Required net positive suction head in feet of head or psig.
  - i. Pump rpm.
  - j. Impeller diameter in inches.
  - k. Motor make and frame size.
  - l. Motor horsepower and rpm.
  - m. Voltage at each connection.
  - n. Amperage for each phase.
  - o. Full-load amperage and service factor.
  - p. Seal type.
2. Test Data (Indicated and Actual Values):
    - a. Static head in feet of head or psig.
    - b. Pump shutoff pressure in feet of head or psig.
    - c. Actual impeller size in inches.
    - d. Full-open flow rate in gpm.
    - e. Full-open pressure in feet of head or psig.
    - f. Final discharge pressure in feet of head or psig.
    - g. Final suction pressure in feet of head or psig.
    - h. Final total pressure in feet of head or psig.
    - i. Final water flow rate in gpm.
    - j. Voltage at each connection.
    - k. Amperage for each phase.
- I. Instrument Calibration Reports:
    1. Report Data:
      - a. Instrument type and make.
      - b. Serial number.
      - c. Application.
      - d. Dates of use.
      - e. Dates of calibration.

## 2.13 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- B. Engineer or Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be

considered incomplete and shall be rejected.

- E. If TAB work fails, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
  - 3. If the second verification also fails, Owner may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

#### 2.14 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

## SECTION 23 07 13 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Outdoor, concealed supply and return.
  - 6. Outdoor, exposed supply and return.
- B. Related Sections:
  - 1. Section 230716 "HVAC Equipment Insulation."
  - 2. Section 230719 "HVAC Piping Insulation."
  - 3. Section 233113 "Metal Ducts" for duct liners.
- C. Insulation to be in accordance with ASHRAE 90.1-2016.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Design Submittals:
  - 1. For each type of insulation product indicated, include thermal conductivity, water-vapor permeability for closed cell insulations, thickness, applicable ASTM standard specification, and jackets (both factory- and field-applied, if any). For each type of vapor retarder or jacket specified, include water vapor permeability, required thickness, and applicable ASTM standard specification.
  - 2. Product Data: For adhesives, indicating VOC content.
  - 3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
  - 4. Product Data: For coatings, indicating VOC content.
  - 5. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.
  - 6. Product Data: For sealants, indicating VOC content.
  - 7. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties, and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

### 1.03 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### 1.04 QUALITY ASSURANCE

- A. Install insulation in accordance with the manufacturer's instructions.

Material Certifications: Manufacturers can provide information regarding material and testing certifications from a qualified testing agency acceptable to authorities having jurisdiction (AHJ). The AHJ can use this information for indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. (Many companies published compliance data on public data sheets while also offering technical resources for additional information. The wording was adjusted to reflect this.)

- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency. Suggestion: or proper documentation indicating compliance. (Some fabricated materials used by the industry do not come directly from the manufacturer, so this documentation can be provided in those cases).
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

## PART 2 - PRODUCTS

### 2.01 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871. Products that come in contact with austenitic stainless-steel operating at temperatures between 140°F and 250°F shall have a leachable chloride content in accordance with the limits set by ASTM C795 (Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel).
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795. See above.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, [Type I] Factory-applied jacket

requirements are specified in "Factory-Applied Jackets"

Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA, or Type IB. For duct and plenum applications, provide insulation with factory applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning.

## 2.02 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M.
    - b. CertainTeed Corporation.

## 2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
  2. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
  2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Corning Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. P.I.C. Plastics, Inc.
    - d. Speedline Corporation.
  2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

#### 2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. VOC Content: 420 g/L or less.
  2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Foster Brand; H. B. Fuller Construction Products.
    - b. Knauf Insulation.
    - c. Vimasco Corporation.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg. F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.

## 2.05 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250° F.
  5. Color: Aluminum.
  6. Sealant shall have a VOC content of 420 g/L or less.
  7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250° F.
  5. Color: White.
  6. Sealant shall have a VOC content of 420 g/L or less.
  7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
  4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
- B. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

**2.07 FIELD-APPLIED FABRIC-REINFORCING MESH**

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Childers Brand; H. B. Fuller Construction Products.

**2.08 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. P.I.C. Plastics, Inc.
    - c. Proto Corporation.
    - d. Speedline Corporation.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
- D. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. ITW Insulation Systems; Illinois Tool Works, Inc. Johns Manville
    - c. RPR Products, Inc.
  2. [Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size].
  3. Finish and thickness are indicated in field-applied jacket schedules.
  4. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
  5. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.
- E. Self-Adhesive Outdoor Jacket: 6014-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross laminated polyethylene film covered with stucco-embossed aluminum-foil facing.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Polyguard Products, Inc.
    - b. VentureClad by 3M

**2.09 TAPES**

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Compac Corporation.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
    - e. Venture Tape.
  2. Width: 3 inches
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces' force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Compac Corporation.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
    - e. Venture Tape.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces' force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Compac Corporation.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
    - e. Venture Tape.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces' force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.

## 2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ITW Insulation Systems; Illinois Tool Works, Inc.
  - b. RPR Products, Inc.
- B. Insulation Pins and Hangers:
- 1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) AGM Industries, Inc.
      - 2) Gemco.
      - 3) Hardcast, Inc.
      - 4) Midwest Fasteners, Inc.
      - 5) Nelson Stud Welding.
    - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - c. Spindle: Aluminum, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  - 2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Gemco.
      - 2) Midwest Fasteners, Inc.
    - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1 ½ inches in diameter.
    - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2 ½ inches.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  - 3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) AGM Industries, Inc.
      - 2) Gemco.
      - 3) Hardcast, Inc.
      - 4) Midwest Fasteners, Inc.
    - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - c. Spindle: Aluminum, fully annealed, 0.106-inch-diameter shank, length to suit

- depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.
  - 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1 ½ inches in diameter.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) AGM Industries, Inc.
      - 2) Gemco.
      - 3) Hardcast, Inc.
      - 4) Midwest Fasteners, Inc.
      - 5) Nelson Stud Welding.
    - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
    - c. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1 ½ inches in diameter.
    - d. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Gemco.
      - 2) Midwest Fasteners, Inc.
  - C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
  - D. Wire: 0.062-inch soft-annealed, galvanized steel.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      - a. C & F Wire.
- 2.11 CORNER ANGLES
- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
  - B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

#### **3.02 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even

- surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
  - C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
  - D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
  - E. Install multiple layers of insulation with longitudinal and end seams staggered.
  - F. Keep insulation materials dry during storage, application, and finishing.
  - G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
  - H. Install insulation with least number of joints practical.
  - I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
    - 1. Install insulation continuously through hangers and around anchor attachments.
    - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
    - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
  - K. Install insulation with factory-applied jackets as follows:
    - 1. Draw jacket tight and smooth.
    - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
    - 3. Overlap jacket longitudinal seams at least 1 ½ inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      - a. For below ambient services, apply vapor-barrier mastic over staples.
    - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
    - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
  - L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
  - M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
  - N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.03 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.04 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches' maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches

- o.c. each way, and 3 inches' maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not over compress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg. F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  - 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  - 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  - 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive, tape, or and insulation pins. Follow manufacturer's installation instructions.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not over compress insulation during installation.

- e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory or field applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50°F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.05 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1 ½ -inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.06 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

### 3.07 FINISHES

- A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.
- D. Local building code and fire marshal shall approve before painting.

### 3.08 FIELD QUALITY CONTROL

- A. Perform tests and inspections. Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.09 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply, return and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  - 7. Outdoor, concealed supply, return, locker room / shower exhaust.
  - 8. Outdoor, exposed supply, return, locker room / shower exhaust.
- B. Items Not Insulated:
  - 1. Fibrous-glass ducts.
  - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 3. Factory-insulated flexible ducts.
  - 4. Factory-insulated plenums and casings.



5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

### 3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 0.75-lb/cu. Ft. nominal density. "R" value of 4.2.
- B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 0.75-lb/cu. Ft nominal density. "R" value of 4.2.
- C. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 0.75-lb/cu. Ft nominal density. "R" value of 4.2.
- D. Concealed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 0.75-lb/cu. Ft. nominal density. "R" value of 4.2.
- E. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket; thickness as required to achieve 2-hour fire rating.
- F. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 3-lb/cu. ft. nominal density. "R" value of 4.2.
- G. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 3-lb/cu. ft. nominal density. "R" value of 4.2.
- H. Exposed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 3-lb/cu. ft. nominal density. "R" value of 4.2.
- I. Exposed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 3-lb/cu. ft. nominal density. "R" value of 4.2.
- J. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket; thickness as required to achieve 2-hour fire rating.

### 3.11 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
  1. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber board 3 inches thick and 6-lb/cu. ft. nominal density. "R" value of 8.3.
  2. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 6-lb./cu. ft. nominal density. "R" value of 8.3.
  3. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 6-lb/cu. ft. nominal density. "R" value of 8.3.
  4. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 6-lb/cu. ft. nominal density. "R" value of 8.3.
  5. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 6-lb/cu. ft. nominal density. "R" value of 8.3.
  6. Concealed, locker room / shower exhaust Insulation: Mineral-fiber board, 3 inches thick and 6-lb/cu. ft. nominal density. "R" value of 8.3.
  7. Exposed, locker room / shower exhaust: Mineral-fiber board, 3 inches thick and 6-lb/cu. ft. nominal density. "R" value of 8.3.

### 3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
  - 1. Ducts and Plenums, Concealed:
    - a. None.
  - 2. Ducts and Plenums, Exposed:
    - a. None.

### 3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
  - 1. Ducts and Plenums, Concealed:
    - a. None.
  - 2. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches.
    - a. Aluminum, Smooth: 0.020 inch thick.
  - 3. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
    - a. Painted Aluminum, Smooth 4-by-1-Inch Box Ribs: 0.040 inch thick.

END OF SECTION

## **SECTION 23 07 19 - HVAC PIPING INSULATION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section includes insulating the following HVAC piping systems:
  - 1. Chilled-water and brine piping, indoors
  - 2. Heating hot-water piping, indoors
  - 3. Refrigerant suction and hot-gas piping, indoors and outdoors.
- B. Related Sections:
  - 1. Section 230713 "Duct Insulation."
  - 2. Section 230716 "HVAC Equipment Insulation."

#### **1.02 ACTION SUBMITTALS**

- A. Product Data: For each type of insulation product indicated, include thermal conductivity, water-vapor permeability for closed cell insulations, thickness, applicable ASTM standard specification, and jackets (both factory- and field-applied, if any). For each type of vapor retarder or jacket specified, include water vapor permeability, required thickness, and applicable ASTM standard specification.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.

#### **1.03 INFORMATIONAL SUBMITTALS (Only as necessary)**

- A. Field quality-control reports.

#### **1.04 QUALITY ASSURANCE**

- A. Material Certifications: Manufacturers can provide information regarding material and testing certifications from a qualified testing agency acceptable to authorities having jurisdiction (AHJ). The AHJ can use this information for indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency

acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## **PART 2 - PRODUCTS**

### **2.01 INSULATION MATERIALS**

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871. Products that come in contact with austenitic stainless-steel operating at temperatures between 140°F and 250°F shall have a leachable chloride content in accordance with the limits set by ASTM C795 (Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel).
- C. Insulation materials for use on austenitic stainless-steel operating at temperatures between 140°F and 250°F shall be qualified as acceptable according to ASTM C 795. (Same reasoning as above)
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Pittsburgh Corning Corporation.
  2. Block Insulation: ASTM C 552, Type I.
  3. Special-Shaped Insulation: ASTM C 552, Type III.
  4. Board Insulation: ASTM C 552, Type IV.
  5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
  6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
  7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.

- c. K-Flex USA.
- H. Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 1290, Type I.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning.
- J. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Manson Insulation Inc.
    - d. Owens Corning.
  - 2. Type I, 850 deg. F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 3. Type II, 1200 deg. F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- K. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory-applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Owens Corning.

## 2.02 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Ramco Insulation, Inc.

## 2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no

- flammable solvents, with a service temperature range of minus 100 to plus 200 deg. F.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Foster Brand; H. B. Fuller Construction Products.
  2. Adhesives shall have a VOC content of 50 g/L or less.
  3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. K-Flex USA.
  2. Adhesives shall have a VOC content of 50 g/L or less.
  3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
  2. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
  2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- F. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Corning Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. P.I.C. Plastics, Inc.
    - d. Speedline Corporation.
  2. Adhesive shall have a VOC content of 80 g/L or less (if available) when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

#### 2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. VOC Content: 420 g/L or less.
  2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Foster Brand; H. B. Fuller Construction Products.
    - b. Knauf Insulation.
    - c. Vimasco Corporation.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg. F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.

#### 2.05 SEALANTS

- A. Joint Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
    - e. Pittsburgh Corning Corporation.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Permanently flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 100 to plus 300 deg. F.

5. Color: White or gray.
  6. Sealant shall have a VOC content of 420 g/L or less.
  7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. FSK and Metal Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. Mon-Eco Industries, Inc.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg. F.
  5. Color: Aluminum.
  6. Sealant shall have a VOC content of 420 g/L or less.
  7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg. F.
  5. Color: White.
  6. Sealant shall have a VOC content of 420 g/L or less.
  7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
  4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.



5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A.

## 2.07 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Foster Brand; H. B. Fuller Construction Products.
    - b. Vimasco Corporation.

## 2.08 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. P.I.C. Plastics, Inc.
    - c. Proto Corporation.
    - d. Speedline Corporation.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45 and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  1. Sheet and roll stock ready for shop or field sizing.
  2. Finish and thickness are indicated in field-applied jacket schedules.
  3. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
  4. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
  5. Factory-Fabricated Fitting Covers:
    - a. Same material, finish, and thickness as jacket.
    - b. Preformed 2-piece or gore, 45 and 90-degree, short and long-radius elbows.
    - c. Tee covers.
    - d. Flange and union cover.
    - e. End caps.
    - f. Beveled collars.
    - g. Valve covers.
    - a. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

- E. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Polyguard Products, Inc.
- F. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Johns Manville; Saranex 540CX Vapor Retarder Film.
- G. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Johns Manville; Saranex 540CX Vapor Retarder Film.
- H. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Johns Manville; Saranex 540CX Vapor Retarder Film or Saranex 560CX Vapor Retarder Film.

## 2.09 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Compac Corporation.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
    - e. Venture Tape.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces' force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of

- the following:
- a. Avery Dennison Corporation, Specialty Tapes Division.
  - b. Compac Corporation.
  - c. Ideal Tape Co., Inc., an American Biltrite Company.
  - d. Knauf Insulation.
  - e. Venture Tape.
2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces' force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Compac Corporation.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.
    - c. Venture Tape.
    - d. PVC Z-Tape, Z-Tape II, Johns Manville, a Berkshire-Hathaway Company
  2. Width: 2 inches.
  3. Thickness: 6 mils. (5-10 mil)
  4. Adhesion: 64 ounces' force/inch in width or (14-64 oz)
  5. Elongation: 150 -500 percent.
  6. Tensile Strength: 18 lbf/inch in width or (15-27 lbf/inch)
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division.
    - b. Compac Corporation.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
    - e. Venture Tape.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces' force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. ITW Insulation Systems; Illinois Tool Works, Inc.
  2. Width: 3 inches.
  3. Film Thickness: 4 mils.
  4. Adhesive Thickness: 1.5 mils.
  5. Elongation at Break: 145 percent.
  6. Tensile Strength: 55 lbf/inch in width.
- F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. PVDC Tape for Indoor and outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive. (Since PVDC is not suitable for being left exposed outdoors, it is not the thickness that determines what thickness should be used but, rather, the desired permeance which is largely a factor of the pipe temperature. I recommend making this section applicable to both indoor and outdoor applications of PVDC Tape since the same tapes can be used in either application.)  
See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Division 01 Section "Product Requirements."  
Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:  
Johns Manville; Saranex 520CX Vapor Retarder Tape or Saranex 560CX Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

## 2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with closed seal.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville
    - b. RPR Products, Inc.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel, or Monel.
- C. Wire: 0.080-inch nickel-copper alloy.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. C & F Wire.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with

requirements for heat tracing that apply to insulation.

- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Install outermost layer of insulation with longitudinal seams at the 3:00 and 9:00 positions of horizontal runs. (Longitudinal seams should be at the sides of horizontal pipe to avoid being stressed from pipe supports, being walked on, having things hung from the insulated pipe, etc. If there will be stresses applied to insulated pipe, it is most likely to be at the top or bottom of the pipe so you do not want to have the joints in the outermost layer at these locations). Check with manufacturer depending upon application.
- K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Jackets without a self-sealing lap are typically stapled or taped. Jackets like an ASJ jacket that have a self-sealing Lap adhesive system are not usually stapled for indoor

- applications. For below ambient air systems, any penetrations made in the vapor-retarder jacket needs to be sealed with appropriate vapor-retarder tape or mastic.
4. Overlap jacket longitudinal seams at least 1 ½ inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  5. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- Q. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.

### 3.03 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.

4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):  
Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.04 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh.

- Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.05 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:



1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.06 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Use the ASL-SSL pressure sensitive adhesive lap seal, and butt (circumferential) strips to seal the seams and joints respectively. Penetrations can be sealed with pressure-sensitive adhesive tape or vapor-retarder mastic. Follow manufacturer's instructions, which include sealing lap seal and butt strips having pressure-sensitive adhesive surfaces. When adhered, the lap and butt strips must be pressurized by rubbing firmly with a plastic squeegee or the back of a knife blade to ensure positive closure. For specific installations, secure each layer of Unfaced preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials. Check with manufacturer for instructions.
  2. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  3. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  4. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
  5. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  4. Install insulation to flanges as specified for flange insulation application.

### 3.07 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1 ½ -inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. On horizontal pipe, overlap longitudinal seams arranged to shed water and locate longitudinal seams at 3:00 or 9:00 position on pipe. Seal end joints with weatherproof sealant recommended by insulation manufacturer. On vertical pipe, overlap end joint seams arranged to shed water and locate longitudinal joints to face away from prevailing wind. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints. Where PVDC jackets are indicated, install as follows: Apply wraps of filament tape at ends of each insulation section and on 12 inch centers to secure pipe insulation to pipe prior to installation of PVDC jacket.
- Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
- Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
- Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal.

Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.

Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

- D. Where PVDC jackets are indicated, install as follows:
1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
  2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
  3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
  4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33 ½ - inches or less. The 33 ½ -inch-circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
  5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

### 3.08 FINISHES

- A. Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.09 FIELD QUALITY CONTROL

- A. Perform tests and inspections.  
B. Tests and Inspections:

Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of

threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  1. Drainage piping located in crawl spaces.
  2. Underground piping.
  3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
  4. Geothermal heat pump supply and return piping.

### 3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Chilled Water and Brine, above 40 Deg. F: Insulation shall be [ one of] the following:
  1. Cellular Glass: 1 ½" thick.
  2. Flexible Elastomeric: 1 ½ inches thick.
  3. Mineral-Fiber, 1 ½ inches thick.
  4. Polyolefin: 1 ½ inches thick.
- B. Heating-Hot-Water Supply and Return, 200 Deg. F and Below: Insulation shall be [ one of] the following:

	Temp	Up to 1"	Up to 1.5"	Up to 4"	Up to 8"	8" & Up
<b>1. Hot Water</b>						
a) Heating HW	140-200	1.5"	1.5"	2"	2"	2"

- 1. Cellular Glass: 1 ½" (up to 1.5" dia. Pipe). 2" (2" dia. Pipe and above).
- 2. Mineral-Fiber, Preformed Pipe, Type I: 1-1/" (up to 1.5" dia. Pipe). 2" (2" dia. Pipe and above).
- C. Refrigerant Suction and Hot-Gas Piping: Flexible elastomeric, 1 inch thick.
- D. Refrigerant Suction and Hot-Gas Flexible Tubing: Flexible elastomeric, 1 inch thick.
- E. Dual-Service Heating and Cooling, 40 to 200 Deg. F: Insulation shall be [ one of] the following:
  1. Cellular Glass: 1 ½ inches thick.
  2. Mineral-Fiber, Preformed Pipe, Type I: 1 ½ inches thick.
- F. Condensate Piping: Mineral-fiber, preformed pipe insulation, 1 inch thick.

### 3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Chilled Water and Brine: Insulation shall be one of the following:
  - 1. Cellular Glass: 3 inches thick.
  - 2. Flexible Elastomeric: 3 inches thick.
  - 3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 3 inches thick.
- B. Heating-Hot-Water Supply and Return, 200 Deg. F and Below: Insulation shall be one of the following:
  - 1. Cellular Glass: 3 inches thick.
  - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 3 inches thick.
- C. Refrigerant Suction and Hot-Gas Piping: Insulation shall be one of the following:
  - 1. Cellular Glass: 2 inches thick.
  - 2. Flexible Elastomeric: 2 inches thick.
  - 3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- D. Refrigerant Suction and Hot-Gas Flexible Tubing: Insulation shall be the following:
  - 1. Flexible Elastomeric: 2 inches thick.
- E. Dual-Service Heating and Cooling: Insulation shall be one of the following:
  - 1. Cellular Glass: 3 inches thick.
  - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

### 3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  - 1. None.
- D. Piping, Exposed:
  - 1. Aluminum, Smooth: 0.020 inch thick.

### 3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  - 1. Aluminum, Smooth: 0.016 inch thick.
- D. Piping, Exposed:
  - 1. PVC: 20 mils thick.

### 3.15 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

## SECTION 23 09 23.11 - CONTROL VALVES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes control valves and actuators for DDC systems.
- B. Related Requirements:
  - 1. Section 230923 "Direct-Digital Control System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
  - 2. Section 230933 "Electric and Electronic Control System for HVAC" for electric/electronic control valves and actuators in electric and electronic control systems.
  - 3. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 230923.11.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include diagrams for power, signal, and control wiring.
  - 2. Include diagrams for pneumatic signal and main air tubing.
- C. Delegated-Design Submittal:
  - 1. Schedule and design calculations for control valves and actuators, including the following:
    - a. Flow at project design and minimum flow conditions.
    - b. Pressure differentials drop across valve at project design flow condition.
    - c. Maximum system pressure differential drop (pump close-off pressure) across valve at project minimum flow condition.
    - d. Design and minimum control valve coefficient with corresponding valve position.
    - e. Maximum close-off pressure.
    - f. Leakage flow at maximum system pressure differential.
    - g. Torque required at worst case condition for sizing actuator.
    - h. Actuator selection indicating torque provided.

#### 1.03 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

## PART 2 - PRODUCTS

### 2.01 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. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.
- C. Delegated Design: Engage a qualified manufacturer to size products where indicated as delegated design.
- D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.
- E. Determine control valve sizes and flow coefficients by ISA 75.01.01.
- F. Control valve characteristics and rangeability shall comply with ISA 75.11.01.
- G. Selection Criteria:
  - 1. Control valves shall be suitable for operation at following conditions:
    - a. Chilled Water: 44F-56F.
    - b. Heating Hot Water: 180F-160F.
    - c. Steam: 5-25 lbs. of pressure.
  - 2. Fail positions unless otherwise indicated:
    - a. Chilled Water: Last position.
    - b. Heating Hot Water: Open.
    - c. Steam: Open.
  - 3. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
  - 4. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 12' head at design flow unless otherwise indicated.
  - 5. Modulating valve sizes for steam service shall provide a pressure drop at design flow equal to lesser of the following:
    - a. 50 percent of the valve inlet pressure.
    - b. 50 percent of the absolute steam pressure at the valve inlet.

### 2.02 BALL-STYLE CONTROL VALVES

- A. Ball Valves with Single Port and Characterized Disk:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Belimo Aircontrols (USA), Inc.
  - 2. Pressure Rating for NPS 1-inch and Smaller: Nominal 600 WOG.
  - 3. Pressure Rating for NPS 1 ½ -inch through NPS 2-inch: Nominal 400 WOG.
  - 4. Close-off Pressure: 200 psig.
  - 5. Process Temperature Range: Zero to 212 deg. F.
  - 6. Body and Tail Piece: Cast bronze ASTM B 61, ASTM B 62, ASTM B 584, or forged brass with nickel plating.
  - 7. End Connections: Threaded (NPT) ends.
  - 8. Ball: Bronze or 300 series stainless steel.
  - 9. Stem and Stem Extension:
    - a. Material to match ball.

- b. Blowout-proof design.
    - c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.
  - 10. Ball Seats: Reinforced PTFE.
  - 11. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
  - 12. Flow Characteristic: Equal percentage.
- B. Ball Valves with Two Ports and Characterized Disk:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Belimo Aircontrols (USA), Inc.
  - 2. Pressure Rating for NPS 1-inch and Smaller: Nominal 600 WOG.
  - 3. Pressure Rating for NPS 1 ½ -inch through NPS 2-inch: Nominal 400 WOG.
  - 4. Close-off Pressure: 200 psig.
  - 5. Process Temperature Range: Zero to 212 deg. F.
  - 6. Body and Tail Piece: Cast bronze ASTM B 61, ASTM B 62, ASTM B 584, or forged brass with nickel plating.
  - 7. End Connections: Threaded (NPT) ends.
  - 8. Ball: [Chrome-plated brass or bronze] [or] [300 series stainless steel].
  - 9. Stem and Stem Extension:
    - a. Material to match ball.
    - b. Blowout-proof design.
    - c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.
  - 10. Ball Seats: Reinforced PTFE.
  - 11. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
  - 12. Flow Characteristics for A-Port: Equal percentage.
  - 13. Flow Characteristics for B-Port: Modified for constant common port flow.
- C. Pressure-Independent Ball Valves NPS 2-inch and Smaller:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Belimo Aircontrols (USA), Inc.
    - b. HCI; Hydronics Components Inc.
  - 2. Performance:
    - a. Pressure Rating: 600 psig for NPS 1-inch and 400 psig for NPS 1 ½ -inch and NPS 2-inch.
    - b. Close-off pressure of 200 psig.
    - c. Process Temperature Range: Between Zero to 212 deg. F.
    - d. Rangeability: 100 to 1.
  - 3. Integral Pressure Regulator: Located upstream of ball to regulate pressure, to maintain a constant pressure differential while operating within a pressure differential range of 5 to 50 psig.
  - 4. Body: Forged brass, nickel plated, and with threaded ends.



5. Ball: Chrome-plated brass.
6. Stem and Stem Extension: Chrome-plated brass, blowout-proof design.
7. Stem sleeve or other approved means to allow valve to be opened and closed without damaging field-applied insulation and insulation vapor barrier seal.
8. Ball Seats: Reinforced PTFE.
9. Stem Seal: Reinforced PTFE packing ring stem seal with threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if equivalent cycle endurance can be achieved.
10. Flow Characteristic: Equal percentage.

## 2.03 BUTTERFLY-STYLE CONTROL VALVES

### A. Commercial-Grade, Two-Way Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Keystone; Tyco Flow Control.
2. Performance:
  - a. Bi-directional bubble tight shutoff at 250 psig.
  - b. Comply with MSS SP-67 or MSS SP-68.
  - c. Rotation: Zero to 90 degrees.
  - d. Linear or modified equal percentage flow characteristic.
3. Body: Cast iron ASTM A 126, Class B, ductile iron ASTM A 536 or cast steel ASTM A 216/A 216M WCB fully lugged, suitable for mating to ASME B16.5 flanges.
4. Disc: 316 stainless steel.
5. Shaft: 316 or 17-4 PH stainless steel.
6. Seat: Reinforced EPDM or reinforced PTFE with retaining ring.
7. Shaft Bushings: Reinforced PTFE or stainless steel.
8. Replaceable seat, disc, and shaft bushings.
9. Corrosion-resistant nameplate indicating:
  - a. Manufacturer's name, model number, and serial number.
  - b. Body size.
  - c. Body and trim materials.
  - d. Flow arrow.

### B. Commercial-Grade, Three-Way Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Keystone; Tyco Flow Control.
2. Arrangement: Two valves mated to a fabricated tee with interconnecting mechanical linkage.
3. Performance:
  - a. Bi-directional bubble tight shutoff at 250 psig.
  - b. Comply with MSS SP-67 or MSS SP-68.
  - c. Rotation: Zero to 90 degrees.
  - d. Linear or modified equal percentage flow characteristic.
4. Body: Cast iron ASTM A 126, Class B, ductile iron ASTM A 536 or cast steel ASTM A 216/A 216M WCB fully lugged, suitable for mating to ASME B16.5 flanges.
5. Disc: 316 stainless steel.

6. Shaft: 316 or 17-4 PH stainless steel.
7. Seat: Reinforced EPDM or reinforced PTFE seat with retaining ring.
8. Shaft Bushings: Reinforced PTFE or stainless steel.
9. Replaceable seat, disc, and shaft bushings.
10. Corrosion-resistant nameplate indicating:
  - a. Manufacturer's name, model number, and serial number.
  - b. Body size.
  - c. Body and trim materials.
  - d. Flow arrow.

## 2.04 GLOBE-STYLE CONTROL VALVES

- A. General Globe-Style Valve Requirements:
  1. Globe-style control valve body dimensions shall comply with ISA 75.08.01.
  2. Construct the valves to be serviceable from the top.
  3. For cage guided valves, trim shall be field interchangeable for different valve flow characteristics, such as equal percentage, linear, and quick opening.
  4. Reduced trim for one nominal size smaller shall be available for industrial valves NPS 1-inch and larger.
  5. Replaceable seats and plugs.
  6. Furnish each control valve with a corrosion-resistant nameplate indicating the following:
    - a. Manufacturer's name, model number, and serial number.
    - b. Body and trim size.
    - c. Arrow indicating direction of flow.
- B. Two-Way Globe Valves NPS 2-inch and Smaller:
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Johnson Controls, Inc.
  2. Globe Style: Single port.
  3. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
  4. End Connections: Threaded.
  5. Bonnet: Screwed.
  6. Packing: PTFE V-ring.
  7. Plug: Top guided.
  8. Plug, Seat, and Stem: [Brass] [or] [stainless steel].
  9. Process Temperature Range: 35 to 248 deg. F.
  10. Ambient Operating Temperature: 35 to 150 deg. F.
  11. Leakage: FCI 70-2, Class IV.
  12. Rangeability: 25 to 1.
  13. Equal percentage flow characteristic.
- C. Three-Way Globe Valves NPS 2-inch and Smaller:
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Johnson Controls, Inc.
  2. Globe Style: Mix flow pattern.
  3. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
  4. End Connections: Threaded.

5. Bonnet: Screwed.
  6. Packing: PTFE V-ring.
  7. Plug: Top guided.
  8. Plug, Seat, and Stem: [Brass] [or] [stainless steel].
  9. Process Temperature Range: 35 to 248 deg. F.
  10. Ambient Operating Temperature: 35 to 150 deg. F.
  11. Leakage: FCI 70-2, Class IV.
  12. Rangeability: 25 to 1.
  13. Linear flow characteristic.
- D. Two-Way Globe Valves NPS 2 ½ -inch to NPS 6-inch:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Johnson Controls, Inc.
  2. Globe Style: Single port.
  3. Body: Cast iron complying with ASME B61.1, Class 125.
  4. End Connections: Flanged, suitable for mating to ASME B16.5, Class 150 flanges.
  5. Bonnet: Bolted.
  6. Packing: PTFE cone-ring.
  7. Plug: Top or bottom guided.
  8. Plug, Seat, and Stem: Brass or stainless steel.
  9. Process Temperature Rating: 35 to 281 deg. F.
  10. Leakage: 0.1 percent of maximum flow.
  11. Rangeability: Varies with valve size between 6 and 10 to 1.
  12. Modified linear flow characteristic.
- E. Industrial-Grade Straight-Through Globe Valves NPS 1-inch and Larger:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Fisher Valves & Instruments; Emerson Process Management.
  2. Globe Style: Single port.
  3. Body: Cast iron or cast steel.
  4. End Connections for NPS 2-inch: Threaded.
  5. End Connections for NPS 2 ½ -inch and Larger: Raised face flanged.
  6. Bonnet: Bolted.
  7. Packing: PTFE V-ring.
  8. Plug: Cage guided and unbalanced.
  9. Plug, Seat, and Stem: 416 stainless-steel plug and seat, 17-4 PH stainless-steel cage and 316 stainless-steel stem.
  10. Valve Stem: Thread and pin stem to plug.
  11. Valve Stem Finish: Polished to 5 micro inches rms or less.
  12. Plug and Seat Surfaces: Hardened facing.
  13. Process Temperature Range: Zero to 450 deg. F.
  14. Ambient Operating Temperature: Minus 20 to plus 150 deg. F.
  15. Leakage: FCI 70-2, Class V.
  16. Flow Characteristic: Linear.

## 2.05 SOLENOID VALVES

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

1. ASCO Valve, Inc.
- B. Description:
  1. Action: Either normally open or normally closed in the event of electrical power failure as required by the application.
  2. Size to close against the system pressure.
  3. Manual override capable.
  4. Heavy-duty assembly.
  5. Body: Brass.
  6. Seats and Discs: NBR or PTFE.
  7. Solenoid Enclosure: NEMA 250, Type 4.

## 2.06 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

- A. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.
- B. Actuators for Steam Control Valves: Shutoff against 1.5 times steam design pressure.
- C. Position indicator and graduated scale on each actuator.
- D. Type: Motor operated, with or without gears, electric and electronic.
- E. Voltage: Voltage selection delegated to the controls contractor and to be coordinated with the electrical contractor.
- F. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
- G. Function properly within a range of 85 to 120 percent of nameplate voltage.
- H. Construction:
  1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
  2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
  3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
- I. Field Adjustment:
  1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
  2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.
- J. Two-Position Actuators: Single direction, spring return or reversing type.
- K. Modulating Actuators:
  1. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
  2. Control Input Signal:
    - a. Three Point, Tristate, or Floating Point: Clockwise and counterclockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.
    - b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for [zero to 10] [or] [2 to 10] V dc [and] [4 to 20-mA] signals.
    - c. Pulse Width Modulation (PWM): Actuator drives to a specified position

- according to pulse duration (length) of signal from a dry contact closure, triac sink, or source controller.
- d. Programmable Multi-Function:
    - 1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
    - 2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
    - 3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.
  - L. Position Feedback:
    - 1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
    - 2. Equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
    - 3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.
  - M. Fail-Safe:
    - 1. Where indicated, provide actuator to fail to an end position.
    - 2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
    - 3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.
  - N. Integral Overload Protection:
    - 1. Provide against overload throughout the entire operating range in both directions.
    - 2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.
  - O. Valve Attachment:
    - 1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
    - 2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
    - 3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.
  - P. Temperature and Humidity:
    - 1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg. F.
    - 2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.
  - Q. Enclosure:
    - 1. Suitable for ambient conditions encountered by application.
    - 2. NEMA 250, Type 2 for indoor and protected applications.
    - 3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
    - 4. Provide actuator enclosure with heater and control where required by application.
  - R. Stroke Time:
    - 1. Operate valve from fully closed to fully open within 15 seconds.
    - 2. Operate valve from fully open to fully closed within 15 seconds.
    - 3. Move valve to failed position within 30 seconds.
    - 4. Select operating speed to be compatible with equipment and system operation.

- S. Sound:
1. Spring Return: 62 dBA.
  2. Non-Spring Return: 45 dBA.

## **PART 3 - EXECUTION**

### **3.01 CONTROL VALVE APPLICATIONS**

- A. Control Valves:
1. Select from valves specified in "Control Valves" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
  2. Hydronic System, Two-Way Applications Controlled by Temperature: Ball valves with single port and characterized disk or Butterfly-style valves, commercial-grade, two-way valves.
  3. Hydronic System, Three Way, Controlled by Temperature: Ball valves with two ports and characterized disk or Butterfly-style valves, commercial-grade, three-way valves.

### **3.02 INSTALLATION, GENERAL**

- A. Furnish and install products required to satisfy most stringent requirements indicated.
- B. Install products level, plumb, parallel, and perpendicular with building construction.
- C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 250lb force.
- D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.
- F. Fastening Hardware:
1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
  2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- H. Corrosive Environments:
1. Use products that are suitable for environment to which they will be subjected.
  2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:
    - a. Laboratory exhaust airstreams.

- b. Process exhaust airstreams.
3. Use Type 316 stainless steel tubing and fittings when in contact with a corrosive environment.
4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
5. Where control devices are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

### 3.03 ELECTRIC POWER

- A. All electrical wiring for the control system shall be as specified in the Electrical Section of the Specifications and as required by local codes. The wiring shall be by this contractor. This contractor shall coordinate all power and voltage requirements.
- B. Furnish and install electrical power to products requiring electrical connections.
- C. Furnish and install circuit breakers. Comply with requirements in the electrical specifications.
- D. Furnish and install power wiring. Comply with requirements in the electrical specifications.
- E. Furnish and install raceways. Comply with requirements in the electrical specifications.

### 3.04 CONTROL VALVES

- A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer recommended clearance.
- B. Install flanges or unions to allow drop-in and -out valve installation.
- C. Where indicated, install control valve with three-valve bypass manifold to allow for control valve isolation and removal without interrupting system flow by providing manual throttling valve in bypass pipe.
- D. Install drain valves in piping upstream and downstream of each control valve installed in a three-valve manifold and for each control valve larger than NPS 2-inch.
- E. Install pressure temperature taps in piping upstream and downstream of each control valve larger than NPS 1-inch.
- F. Valve Orientation:
  1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
  2. Install valves in a position to allow full stem movement.
  3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.
- G. Clearance:
  1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
  2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.
- H. Threaded Valves:
  1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
  2. Align threads at point of assembly.

3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
  4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.
- I. Flanged Valves:
1. Align flange surfaces parallel.
  2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- J. Connect electrical devices and components to electrical grounding system. Comply with requirements in the electrical specifications.
- K. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in the electrical specifications.
- L. Install engraved phenolic nameplate with valve identification on valve.

### 3.05 CHECKOUT PROCEDURES

- A. Control Valve Checkout:
1. Check installed products before continuity tests, leak tests, and calibration.
  2. Check valves for proper location and accessibility.
  3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
  4. Verify that control valves are installed correctly for flow direction.
  5. Verify that valve body attachment is properly secured and sealed.
  6. Verify that valve actuator and linkage attachment are secure.
  7. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
  8. Verify that valve ball, disc, and plug travel are unobstructed.
  9. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

### 3.06 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
- B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.
- C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
- D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION



**SECTION 23 09 33 – BUILDING AUTOMATION SYSTEM – HONEYWELL N4 (JAVA BASED).  
SIEMENS ACCEPTED EQUAL**

**PART 1 - GENERAL**

**1.01 OWNERS REQUIREMENTS**

- A. No additional software shall be required to operate, program, or troubleshoot equipment.
- B. All thermostats shall be 24 hr./7 day programmable type, auto changeover type. a +/- 3 degree adjustment by the occupant from the Building Automation System (BAS) setpoint. Thermostats shall not have occupancy override unless otherwise noted in the specifications. Provide locking covers (clear plastic, hinged type).
- C. Samples (snapshots) of the graphics shall be included in the Automatic Temperature Control (ATC) submittal.
- D. All building alarms must be sent to the local/main building alarm page accessed from the main site plan. Generic alarms are not acceptable and must indicate the reason the alarm has been generated. ATC contractor to coordinate with owner and develop alarm categories (critical, non-critical, maintenance, etc.) and identify which category equipment, systems, components, etc. shall be placed. ATC contractor to coordinate owner's notification requirements (local, remote, personnel, emails, texts, etc.). An alarm shall be sent to the main alarm page whenever a controller loses communication for more than 5 minutes.
- E. The ATC contractor shall provide two 4 hour training sessions for systems orientation, product maintenance, trouble shooting, and emergency contacts. ATC contractor to coordinate with owner/architect/engineer to determine representatives/designated staff to be present for the training. ATC contractor to provide one training session during the heating (winter) season and one during the cooling (summer) season.
- F. The user shall have the ability to adjust scheduling blocks for each piece of equipment, floor, building, and the entire campus in addition to the individual zones. (i.e., occupied/unoccupied).
- G. An icon in the Navigation Bar shall display the pdf's of As-Built control diagrams and sequence of operations for all systems within the building/system being viewed. This shall open in a pop-up window.
- H. Furnish all labor, materials, equipment, and service necessary for a complete and operating control system to be integrated with the central building automation system, utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.
- I. Utilizing the BAS supervisor, the system shall be capable of remotely controlling, monitoring, accessing all equipment and systems controls described in this section and the drawings from multiple locations as determined by the client. All equipment and systems shall match and be compatible with the existing Honeywell WEBs System (or similar) used in the university campus.
- J. Contractor to obtain pricing from owner's controls vendor (and include in his bid) for integration work between this project and the existing Honeywell WEBs System (or similar). Provide standard mapping and graphics integration. Contractor to match existing BAS graphics and standards.

- K. Utilize network user function to be programmed into the Server. Passwords will need to be issued by the owner to the contractor prior to programming. No additional users shall be created by the vendor.
- L. Contractor to provide a hyperlink to the Main Site Map to open up each building floor plan showing areas under control (via the BAS).
- M. Provide emergency shut down for all fan forced systems on emergency shut down page on BAS.
- N. System shall be setup for auto backup of JACEs on a weekly basis via the AX Provisioning Service.
- O. Provide 1 year software maintenance agreement for each JACE provided. The contractor is responsible for upgrading and installing any upgrades to the Niagara 4 Software during the warranty period.
- P. Additional Graphics Requirements.
  - 1. Building floor plan display should be color coded for each particular zone. (i.e., AHU zone: Area should be shaded differently than other zones.) Thermostat locations and thermostat number shall be identified.
  - 2. Building floor plan to display current temperatures of those rooms.
  - 3. Notification of a “blinking” red light shall be displayed when an area is in alarm.
  - 4. If a controller is offline or lost power, a default value of last known value should not be displayed. It should be defined as “offline” and an alarm should be programmed into the system to notify that system is “offline.” Unit temperature display shall become yellow.
  - 5. From the building area floor plan graphic, there should be hyperlink created that allows one to proceed to HVAC equipment page for equipment serving that area.
  - 6. Equipment should have an automated graphic display showing a status of equipment. This should be confirmed by both status and command values.
  - 7. The dampers should be displayed in the position that they are physically in.
  - 8. Set points should be displayed on the graphics.
  - 9. Ability to override commands of valves, dampers, fans to be provided to allow system corrections and/or troubleshooting.
  - 10. All programmed schedules to be accessible from the main floor plan page. Allow for click and change ability to modify schedules based on calendar year changes.
  - 11. Pages shall have hyperlinks to navigate to main site home page, building home page, and adjacent floors within the building.
  - 12. In lieu of building specific outdoor temperature and humidity sensors, BAS shall reference the National Weather Service, Philadelphia International Airport. This does not apply to equipment with integral OA Temp/RH sensors.
  - 13. The graphics of a piece of equipment (i.e., fan, motor, etc.) in operation (energized, not energized, etc.) shall be displayed on the graphics to match the operations of the physical piece of equipment.
  - 14. Provide hyperlinking between the equipment to the floor plan.

## 1.02 SUMMARY

- A. Scope: Furnish all labor, materials, and equipment for a complete and operating Building Automation System (BAS) utilizing Direct Digital Controls as shown as drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer open protocol bus (s) such as LonTalk or BACnet.
  - 1. The intent of the specification is to provide to the owner a BAS system(s) running the

Niagara 4™ open NICS framework and be truly “open” at all levels. “Open” by definition includes “Sourcing” and “Product,” and “Service” and “Expansion.” Any contractor or integrator “certified” on Niagara 4 platform must be able to work on any device or network controller or supervisor without having to use other vendors or software to access parts of the network. This can best be described as an “open source,” “open protocol,” “open controller,” “open supervisor” system with “open maintenance” and “system expansion.”

2. BAS Systems that meet “Open definition”:
  - a. **Manufacturers:** Honeywell Inc., Schneider Electric or prior approved equal.
  - b. Control Contractor Requirement:
    - 1) Honeywell ACI or ACS – Certified Contractor.
    - 2) Minimum of (2) WEBS Niagara 4 certified employees.
    - 3) Minimum of (5) WEBS N4 installations with system supervisor interface.
  - c. Preapproved Honeywell ACI and ACS contractors for WEBS-N4™ “installation.”
3. Open NIC Statement

Niagara 4 includes a licensing model that provides OEMs with the ability to define the various levels and types of Niagara 4 interoperability their product will support. There are two primary interactions the NICs address – the sharing of data between stations (JACEs – WEBS-AX™ and Supervisors) and the ability for a tool (i.e., N4 workbench 4.3 or above) to engineer a station.

The NICS provides a structure (or schema) that OEMs can use to define the various levels and types of Niagara 4 interdependability their products will support. The NICs definitions are contained in the license file which is checked by a station or tool when it starts up.

Every licensed station and tool has a (Host ID). This field holds a text descriptor that the OEM chooses as the identifier its product line and each station can have only one Host ID entry.

#### Station Compatibility “In”

The field is a list of brands that this local station will allow Niagara 4™ data to come in from – “this is the list of brands that can accept data from.”

#### Station Compatibility “Out”

This Field is a list of brands that this local station will allow Niagara 4™ data to be shared with.

#### Total Compatibility “In”

This field is a list of brands that this station will allow to be connected to it for engineering of its applications.

#### Total Compatibility “Out”

This field is a list of brands that this tool is allowed to connect to and engineer.

For a BAS System(s) running Niagara 4™ from NICs framework and be truly “Open” at all levels ...

Example: No connectivity restrictions:  
The station and tool “NICs” would be as follows:

Property	Value
Station Compatibility In	All
Station Compatibility Out	All
Total Compatibility In	All
Total Compatibility Out	All

4. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, and Modbus. Non LonTalk communication protocol for specific pieces of equipment must be approved on a case by case basis.
  5. System architecture shall provide secure Web access using MS Internet Explorer from any computer on the owner’s LAN.
  6. All control devices furnished with this Section shall be programmable directly from the Niagara-4™ Workbench upon completion of this project. The use of configurable or programmable controllers that require additional software tools for post-installation maintenance shall not be acceptable.
  7. Any control vendor that must provide additional BAS server software shall be unacceptable. Only systems that utilize the WEBs Niagara 4™ Framework shall satisfy the requirements of this section.
  8. The BAS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus Niagara 4 framework server.
  9. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: “accept.station.in=\*”, “accept.station.out=\*” and “accept.wb.in=\*” and “accept.wb.out=\*”. All open NIC statements shall follow Niagara 4 Open NIC specifications
  10. All JACE hardware products used on this project must be Made in the USA or come through the Tridium Richmond, VA shipping facility. JACE hardware products not meeting these requirements will not be allowed.
- B. Furnish all labor, materials, equipment, and service necessary for a complete and operating control system to be integrated with the central BAS System, utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.
  - C. All control wiring regardless if it is line or low voltage and it performs as control wiring, shall be the ATC contractor’s electrical subcontractor responsibility. ATC contractor to allow for electrical contractor compensation for any line voltage work. Power for operation of valves, dampers, thermostats, and miscellaneous devices is control wiring.
  - D. Drawings of the BAS network and associated systems are diagrammatic only and any apparatus not shown but required to make the system operative to the complete satisfaction of the owner/engineer shall be furnished and installed without additional cost.
  - E. All wiring to be CAT 6 plenum rated in concealed areas and in conduit where exposed or subject to damage. All exterior exposed control wiring to be in conduit and weather protected. Conduit to be EMT or galvanized. No PVC is permitted in plenum.
  - F. This contractor shall conform to the General and Supplementary Conditions Provisions under Division 1 of the Specifications. (Where applicable)
  - G. This contractor shall conform to the Specifications Section 23 05 00: Mechanical General Provisions.

- H. Exposed control wiring in interior finished spaces;
1. Control wiring to run in Wiremold V500 series. (steel raceway, 3/4") and associated fittings.
  2. Finish to be selected by architect.
  3. Contractor to coordinate all final Wiremold run locations and layout with architect/engineer for approval prior to ordering and rough-in.
- I. ATC contractor to be present at equipment/system start-up and verify that all wiring and components are installed correctly and the equipment/system sequence of operation is operating as designed. ATC contractor to perform final calibrations of all devices and equipment. ATC contractor to make all the required corrections if the equipment/system does not operate correctly.
- J. ATC contractor to coordinate with the test, balancing, and adjusting (TBA) contractor prior to performing equipment/systems tests that all air, hydronic and steam systems have been tested and balanced.
- K. The use or installation of all wireless equipment must be pre-approved by the owner and engineer.
- L. Tridium has developed a document that addresses many of the issues that IT managers have relating to Tridium's Niagara 4 Framework™ and platform and station connections. Refer to [www.tridium.com](http://www.tridium.com) for additional document information.
- M. All control panels to be NEMA 3R.

### 1.03 SYSTEM DESCRIPTIONS

- A. The entire BAS shall be comprised of interoperable, stand-alone digital controllers communicating via LonMark™/LonTalk™ and/or ™ communication protocols to a Network Area Controller (NAC). Temperature Control System products shall be by approved manufacturer that meet and fully comply with the intent of Sections 1.1, A.1.
- B. The BAS shall consist of controllers, sensors, thermostats, control valves, dampers, and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and perform functions specified.
- C. The BAS shall be comprised of Network Area Controller(s) (NAC) within the facility. The NAC shall connect to the owner's local or wide area network, depending on configuration. Access to the systems, either locally in this building or remotely from a control site or sites, shall be accomplished through standard WEB browsers, supported MS Internet Explorer via Internet and/or local area network. Each NAC shall communicate to LonMark™/LonTalk™ (ILC) and/or ™ (IBC) controllers and other open protocol system/devices provided under Division 23, Division 26, etc.
- D. The BAS as provided in this Division shall be based on a hierarchical architecture incorporating the Niagara N4 Framework™. All control devices furnished shall be programmable directly from Tridium N4™ Workbench, WEBS Station N4™ or WEB Pro N4™ upon completion of this project. WEBS-N4™ "open" license embedded user interface "UI."

### 1.04 SPECIFICATION NOMENCLATURE - Acronyms used in this specification are as follows:

Actuator	Control device that opens or closes valve or damper in response to control signal.
AI	Analog Input
AO	Analog Output
Analog	Continuously variable state overstated range of values
BAS	Building Automation System

DDC	Direct Digital Control
Discrete	Binary or digital state
DI	Discrete Input
DO	Discrete Output
FC	Failed Closed position of control device or actuator. Devices move to closed position on loss of control signal or energy source.
FO	Fail open (position of control device or actuator). Device Moves to open position on loss of control signal or energy source.
GUI	Graphical User Interface
HVAC	Heating, Ventilating and Air Conditioning
IDC	Interoperable Digital Controller
ILC	Interoperable Lon Controller
LAN	Local Area Network
Modulating	Movement of a control device through an entire range of values,proportional to an infinitively variable input value.
Motorized	Control device with actuator
NAC	Network Area Controller
NC	Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
NO	Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
OSS	Operating System Server, host for system graphics, alarms, trends, etc.
Operator	Same as actuator
PC	Personal Computer
Peer-to-Peer	Mode of communication between controllers in which each device connected to network has equal status and each share its database values with all other devices connected to network.
P	Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
PI	Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
PICS	Product Interoperability Compliance Statement.
PID	Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
Point	Analog or discrete instrument with addressable database value.
WAN	Wide Area Network

TCS	Temperature Control Systems
FMCS	Facility Management Control System
CD	Compact Disc
NICS	NIAGARA 4™ Compatibility Statement – see Part 1.1.3
IBC	Interoperable Controller
I/O Points	AI, AO, DI, DO
ACI	Honeywell designation acronym: Authorized Control Integrator.
ACS	Honeywell designation acronym: Automation Control Specialist
BCS	Honeywell designation acronym: (See ACS)
WBI	WEB Browser Interface
POT	Portable Operator's Terminal
PMI	Power Measurement Interface
OOT	Object Oriented Technology
ASD	Honeywell Designation: Authorized System Distributor
ISO-9001	Model for Quality Assurance in Design/Development, Production, Installation and Servicing.
PEC	Programmable Equipment Controllers
ASC	Application Specific Controllers
AUC	Advance Unitary Controllers
SNC	System Network Controller
SNMP	Simple Network Management Protocol
OEM	Original Equipment Manufacturer
OBDB	Open Database Connectivity
SQL	Structured Query Language

#### 1.05 DIVISION OF WORK

- A. The ATC contractor shall be responsible for all controllers (IDC and IBC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring.
- B. The ATC contractor shall be responsible for the Network Area Controller(s) (NAC), software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, Web Browser pages, setup of schedules, logs and alarms, LonWorks network management and connection of the NAC to the local or Wide Area Network.

#### 1.06 RELATED WORK SPECIFIED ELSEWHERE

- A. Reference General Conditions Section 23 05 00 for all portions of work that applies to BAS or BAS contractor.
- B. Division 26, Electrical:
  - 1. Providing starters and disconnect switches (unless otherwise noted).
  - 2. Power wiring and conduit (unless otherwise noted).
  - 3. Provision, installation and wiring of smoke detectors (unless otherwise noted).
  - 4. Other equipment and wiring as specified in Division 26.
- C. Division 23, Equipment Interface:  
In the event the Division 23 equipment supplier has interface responsibility specified with the BAS, through communications with Lon™,™ or ModBus, the ATC contractor shall be

responsible for the up-loading of I/O points and operational written perimeters, as detailed in Division 23; HVAC equipment and the here after sequence-of-operations to the NAC. It will be the responsibility of the Division 23 manufacturers/equipment supplier to coordinate the time and date with their factory trained control technician to facilitate/accomplish 100%, the I/O points and control perimeters with the ATC contractor to fully meet the specification requirements. Upon completion and testing by both the BAS and the factory technician, all programming software will be given to the BAS for demonstration to the owner and will become property of the owner for use in the future.

- D. Refer to International Mechanical Code.
- E. Refer to National Electrical Code.

#### 1.07 AGENCY AND CODE APPROVALS

- A. All products of the BAS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided on request, with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
  - 1. Federal Communications Commission (FCC), Rules and Regulations, Volume II – July 1986 Part 15 Class A Radio Frequency Devices
  - 2. FCC, Part 15, Subpart J, Class A Computing Devices.
  - 3. UL 504 – Industrial Control Equipment
  - 4. UL 506 – Specialty Transformers
  - 5. UL 910 – Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air-Handling Spaces
  - 6. UL 916 – Energy Management Systems All
  - 7. UL 1449 – Transient Voltage Suppression
  - 8. Standard Test for Flame Propagation Height of Electrical and Optical – Fiber Cables Installed Vertically in Shafts.
  - 9. EIA/ANSI 232-E – Interface Between Data Technical Equipment and Data Circuit Terminal Equipment Employing Serial Binary Data Interchange.
  - 10. EIA 455 – Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices.
  - 11. IEEE C62.41 – Surge Voltages in Low-Voltage AC Power Circuits.
  - 12. IEEE 142- Recommended Practice for Grounding of Industrial and Commercial Power Systems
  - 13. NEMA 250 – Enclosures for Electrical Equipment (SIC)
  - 14. NEMA ICS 1 – Industrial Control Systems
  - 15. NEMA ST 1 – Specialty Transformers
  - 16. NCSBC Compliance, Energy Performance of Control System shall meet or surpass the requirements of ASHRAE/IESNA 90.1.
- B. All BACNET equipment/devices shall bear the “BTL” stamp.
- C. The BAS shall be BACNET-SC (secure connect) capable.

#### 1.08 SOFTWARE OWNERSHIP

- A. The owner shall have full ownership and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BAS.



## 1.09 MECHANICAL GENERAL PROVISIONS

- A. ATC Contractor shall conform to the general and supplemental condition provisions under Division 23 05 00 and this specification.

## 1.10 DELIVERY STORAGE AND HANDLING AND SHIPPING TO OEM FACTORY.

- A. Provide factory shipping cartons for each piece of equipment and control device.
- B. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from the weather.
- C. Factory mounted Components: Where control devices are specified in this section or other specifications such as (equipment) to be factory mounted, the BAS shall arrange for shipping of control devices to equipment manufacturer. He will have responsibility of “tagging” control hardware prior to shipping if requested by equipment supplier. The BAS contractor will have the option of either down-loading program(s) prior to shipping or installing programs after mechanical equipment has been installed at site, unless specific instructions are specified under 1.5C Equipment Interface.

## 1.11 QUALITY ASSURANCE

- A. Single source Responsibility of BAS.
  - 1. The ATC Contractor shall be responsible for the complete installation and proper operations of the control system specified. The control system contractor shall exclusively be in regular and customary business of design, installation, and service of computerized building management systems similar in size and complexity to the system specified. Subcontracting the “Single Service Responsibility” tasks to others covering any of the following: design and submission, graphics, software programming, field check, demonstrating operating compliance and warranty including using Automation System Distributor is not accepted.
  - 2. The ATC Contractor shall have a full service DDC office within 50 miles of the project site. This office shall be staffed with applications’ engineers, software engineers, and field technicians. This office shall maintain parts inventory and shall have all testing and diagnostic equipment to support their work, as well as staff trained in the use of this equipment.
  - 3. The manufacturers of the BAS digital controllers shall, if necessary, provide documentation supporting compliance with ISO-9001.

## 1.12 RELATED WORK SPECIFIED ELSEWHERE

- A. Products Supplied But Not Installed Under This Section:
  - 1. Control valves.
  - 2. Flow switches.
  - 3. Wells, sockets, and other inline hardware for water sensors (temperature, pressure, flow).
  - 4. Automatic control dampers, where not supplied with equipment.
  - 5. Airflow measuring stations.
  - 6. Terminal unit controllers and actuators, when installed by terminal unit manufacturer.
  - 7. Variable Frequency Drives. (This does not include VFDs integral to machinery such as chillers or boilers)

- B. Products Installed But Not Supplied Under This Section:
  - 1. None.
- C. Products Not Furnished or Installed But Integrated with the Work of This Section:
  - 1. Campus chilled water Control Systems.
  - 2. Campus steam control systems.
  - 3. Hot water Control Systems.
  - 4. Dry-coolers/chiller control systems.
  - 5. Pump Control Packages.
  - 6. In-line Meters (water, power).
  - 7. Chemical Water Treatment.
  - 8. Smoke Detectors (through alarm relay contacts).
- D. Work Required Under Division 26 Related to This Section:
  - 1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
  - 2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
  - 3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

## **PART 2 - PRODUCTS**

### 2.01 SYSTEM OVERVIEW

- A. The ATC Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP/IP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.
- B. The BAS server software must support at least the following server platforms: Windows. The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.
- C. The web browser Graphical User Interface (GUI) shall provide a completely interactive user interface and must offer and be configured with the following features as a minimum:
  - 1. Trending.
  - 2. Scheduling.
  - 3. Electrical demand limiting.
  - 4. Duty Cycling.
  - 5. Download Memory to field devices.
  - 6. Real time 'live' Graphic Programs.
  - 7. Tree Navigation.
  - 8. Parameter change of properties.
  - 9. Setpoint Adjustments.
  - 10. Alarm/Event Information.
  - 11. Configuration of operators.
  - 12. Execution of global commands.
  - 13. Add, delete, and modify graphics and displayed data.
- D. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
- E. BAS Server Database: The BAS server software shall utilize a JAVA Database Connectivity

- (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2, BAS systems written to Non-Standard and/or Proprietary databases are NOT acceptable.
- F. Database Open Connectivity: The BAS server database shall allow real time access of data via the following standard mechanisms:
1. Open protocol standard like SOAP
  2. OLE/OPC (for Microsoft Client's/Server platform only)
  3. Import/Export of the database from or to XML (Extensible Mark-up Language)
- G. The installed system shall provide secure password access to all features, functions and data contained in the overall BAS.
- H. Communication Protocol(s): The native protocol of the BAS server software shall be TCP/IP over Ethernet. Proprietary protocols over TCP/IP are NOT acceptable.
- I. Thin Client – Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only the latest version of Microsoft/Firefox will be required as the GUI, and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
  2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit-encryption technology within Secure Socket Layers (SSL). Communication Protocol shall be Hyper-Text Transfer Protocol (HTTP)

## 2.02 WEB BROWSER GRAPHICAL USER INTERFACE (GUI)

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic setpoint controls, configuration menus for operator access, reports, and reporting actions for events.
- B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and password. Navigation in the system shall be dependent on the operator's role privileges, and geographic area of responsibility.
- C. Navigation: Navigation through the GUI shall be accomplished by clicking on appropriate building on a campus site plan.
1. Upon navigating to the site, the page shall be broken into two areas, a Navigation Bar and General Area.
- D. Navigation Bar: The Navigation Bar shall provide General information of the site and basic navigation functions. It is to be located along the top of the page and shall display the following.
1. General information such as current time, outdoor temperature/humidity, building name, and page name.
  2. Navigation information that shall be provided is link back to site plan, to site histories, site specific alarm panel, building schedules, and the sites main home page.
    - a. Alarm Panel: This shall display the current number of unacknowledged alarms for the site and when selected, open the alarm panel in a popup

- window.
- b. Histories: This shall display the histories for the current site being viewed and open in a popup window.
  - c. Sequence of Operation: This shall display the sequence of operations for all equipment within the site being viewed. This shall open in a pop-up window.
- E. General Area: The general area is the main display area for the site. It shall contain information such as floor plans and equipment details.
- 1. Floor Plans: The floor plan shall be created from (CAD or REVIT) backgrounds and shall provide a general overview of the building floors that shows building room numbers and corresponding space temperatures and access to the equipment pages.
  - 2. Equipment pages: The views of equipment shall either be provided in a popup window or on the main general area depending on size of graphic need.
    - a. It shall display a general layout of the equipment and display all points created for the equipment. The user shall also have access to set points and be able to adjust with a simple click. Refer to section 2.04 for additional user adjustment requirements.
- F. Action Pane: The Action Pane shall provide several functional views for each HVAC or mechanical/electrical subsystem specified. A functional view shall be accessed by clicking on the corresponding button.
- 1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floorplans, equipment drawings, active graphic setpoint controls, web content, and other valid HTML elements. The data on each graphic page shall automatically refresh.
  - 2. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the property's pages shall require the operator to depress an 'accept/cancel' button.
  - 3. Schedules: Shall be used to create, modify/edit and view schedules based on the systems geographical hierarchy (using the navigation bar).
  - 4. Alarms: Shall be used to view alarm information geographically (using the navigation bar), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
  - 5. Trends: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling.
  - 6. Logic – Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
  - 7. Other actions such as Print, Help, Command, and Logout shall be available via a dropdown window.
- G. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated, gifs or jpgs, vector scalable, active setpoint graphic controls shall be used to enhance usability. Graphic tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
- 1. Display Size: The GUI workstation software shall graphically display in 1024 by 768 pixels 24 bit True Color.
  - 2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.

3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors based on temperature. Difference from set point Red = temperature above set point; Blue = temperature below set point; additionally, Yellow = lost communication, Dark Red = alarm as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
  4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to indicate status of equipment.
  5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
    - a. Each piece of equipment monitored or controlled including each terminal unit.
    - b. Each building
    - c. Each floor and zone controlled.
- H. Hierarchical Schedules: Utilizing the Navigation Bar displayed in the web browser GUI, an operator (with password access) shall be able to define a Normal (occupied/ unoccupied), holiday or override schedule for an individual piece of equipment or room or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day 'Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Bar. No further operator intervention would be required and every control module in the system would be automatically downloaded with the 'Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Bar shall be shown in a summary schedule table and graph.
1. Schedules: Schedules shall comply with the LonWorks and standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
    - a. Types of schedules shall be Normal, Holiday or override
    - b. A specific date.
    - c. A range of dates.
    - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
  2. Wildcard (example, allow combinations like second Tuesday of every month).
  3. Schedule categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
  4. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an 'individual tenant' group – who may occupy different areas within a building or buildings. Schedules applied to the 'tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the 'tenant group.'
  5. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air

- handling unit, chiller, boiler, and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
6. Partial Day Exceptions: Scheduled events shall be able to accommodate a time range specified by the operator (i.e., board meeting from 6 pm to 9 pm overrides normal schedule for conference room).
  7. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules, and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
  8. The user shall have the ability to adjust scheduling blocks for the entire building in addition to individual zones.
- I. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Bar, shall be displayed in the Action Pane by selecting an 'Alarms' view. Alarms, and reporting actions shall have the following capabilities:
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report, and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address, and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge, or force a return to normal in the Events View as specified in this section.
  2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
  3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
  4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Bar shall be used to setup Alarm Areas in the Graphic Pane.
  5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
  6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A 'network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
  7. Alarm Summary Counter: The view of Alarm in Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm); require acknowledgement, and total number of Alarms in the BAS Server database.
  8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
  9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server

software. Operators shall be able to easily define these Reporting Actions using the Navigation Bar and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:

- a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
  - b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email services support pagers.
  - c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
  - d. Write Property: The write property reporting action updates a property value in a hardware module.
  - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
  - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
10. All building alarms must be sent to the campus alarm page accessed from the campus site plan.
- J. Trends: Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Bar and Graphic Pane.
1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Bar and selecting a Trends button in the Graphic Pane. The system shall allow y- and x- axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
  2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server. Trend data, including run time hours and start time date and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
  3. Resolution: Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis. Provide 15 minute intervals for all trending points unless otherwise noted.
  4. Dynamic Update: Trends shall be able to dynamically update at operator-defined intervals.
  5. Zoom/Pan: It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
  6. Numeric Value Display: It shall be possible to pick any sample on a trend and have the numerical value displayed.
  7. Copy/Paste: The operator must have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e., CTRL+C, CTRL+V).

- K. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Password. Access to different areas of the BAS system shall be defined in terms of Roles, Privileges and geographic area of responsibility as specified:
1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
    - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
    - b. Edit Privileges shall comprise: Setpoint, Tuning and Logic, Manual Override, and Point Assignment Parameters.
    - c. Function Privileges shall comprise: Alarm/Event Acknowledgment Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print, and Alarm/Event Maintenance.
  2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible Navigation Bar. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

## 2.03 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall a GPL is a method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices in conventional control systems, such as relays, switches, high signal selectors, etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then form a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
  2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
  3. Microblocks: Shall be software devices that are represented graphically and maybe connected together to perform a specified sequence. A library of microblocks shall



- be submitted with the control contractors bid.
4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
  5. Reference Labels: Labels shall be similar to wires that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e., two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
  6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
  7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields and shall contain 'push buttons for the purpose of selecting default parameter settings.
  8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
  9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
  10. Live Graphical Programs: The Graphic Programming software must support a 'live' mode, where all input/output data, calculated data, and set points shall be displayed in a 'live real-time mode.
- D. Additional Graphics Requirements.
1. Building floor plan display should be color coded for each particular zone. (i.e., AHU Zone: Area should be shaded differently than other zones.). Thermostat locations and thermostat number shall be identified.
  2. Building floor plan to display current temperatures of those rooms.
  3. Notification of a "blinking" red light shall be displayed when an area is in alarm.
  4. If a controller is offline or lost power, a default value of last known value should not be displayed. It should be defined as "offline" and an alarm should be programmed into the system to notify that system is "offline." Unit temperature display shall become yellow.
  5. From the building area floor plan graphic, there should be hyperlink created that allows one to proceed to HVAC equipment page for equipment serving that area.
  6. Equipment should have an automated graphic display showing a status of equipment. This should be confirmed by both status and command values.
  7. The dampers should be displayed in the position that they are physically in.
  8. Set points should be displayed on the graphics.
  9. Ability to override commands of valves, dampers, fans to be provided to allow system corrections and/or troubleshooting.
  10. All programmed schedules to be accessible from the main floor plan page. Allow for click and change ability to modify schedules based on calendar year changes.
  11. Pages shall have hyperlinks to navigate to main site home page, building home page, and adjacent floors within the building.
  12. In lieu of building specific outdoor temperature and humidity sensors, BAS shall reference the National Weather Service, Philadelphia International Airport. This does not apply to equipment with integral OA Temp/RH sensors.
  13. The graphics of a piece of equipment (i.e., fan, motor, etc.) in operation (energized, not energized, etc.) shall be displayed on the graphics to match the operations of the physical piece of equipment.
  14. Provide hyperlinking between the equipment to the floor plan.

- E. Contractor prior to programming the system graphics, shall obtain approved equipment templates from the owner to keep the graphics consistent.

#### 2.04 BEST PRACTICES:

- A. Local building supervisor:
  - 1. The local supervisor shall have its time synced with the NTP server.
  - 2. The passwords for the platform and administration shall be per the owner's standard.
  - 3. Histories and alarm extensions will reside at this level and then sent up to server.
- B. Campus Supervisor:
  - 1. Local building PX pages shall reside in a folder named for the building and shall not depend on files outside of this for display.
  - 2. New supervisors shall be added to the scheduled backup for of station.

#### 2.05 LONWORKS NETWORK MANAGEMENT

- A. Systems requiring the use of third party LonWorks network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.
- D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.
- E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management databases at all times. Systems employing network management databases that are not resident, at all times, within the control system, shall not be accepted.

#### 2.06 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing the LonWorks technology communication protocol and/or in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- D. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the existing Operating System Server currently located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
  2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

## 2.07 PORTABLE OPERATOR'S TOOL (LAPTOP COMPUTER) (ADD ALTERNATE)

- A. The laptop computer shall consist of an Intel Premium based laptop computer (minimum processing speed of 2.0 GHz with 8GB RAM with minimum 64 bit O.S. and a 500-gigabyte minimum hard drive). It shall include a CD-ROM drive, and appropriate connectors and cables for communication with the Ethernet network. Operating system shall be Microsoft Windows 10 or latest version.

## 2.08 BAS SERVER HARDWARE

- A. Computer Configuration (Hardware Independent)
1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
  2. 2 GHz, Intel Core I5 or higher, Core 2 Dual also acceptable P4 or higher CPU – Dual Processor.
  3. 8 GB of RAM Minimum, 500 gigabyte minimum hard drive, solid state hard drive.
  4. 40 gigabytes hard disk, 1.44M 3 ½" floppy drive, SVGA Card with 1024 x 768, 24-bit True Color, Back-up system 24X CD Rom R/W Drive minimum, 24" Flat Screen Color Monitor, Keyboard, and mouse. Dual band wireless, Bluetooth.
  5. Operating System for the server shall be Microsoft Windows 10 or latest version, 64 bit minimum.
  6. Internet Explorer 11.0 or later
  7. 10/10/1000 Mbps T Ethernet Port
  8. Standard Client: The thin-client Web Browser, BAS GUI shall be Microsoft Internet Explorer (11.0 or later) running on 10 or latest version (with LX Compatibility Mode. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

## 2.09 BAS SERVER FUNCTIONS

- A. A central server shall be provided. The server shall support all Network Area Controllers (NAC) connected to the customer's network whether local or remote.
- B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.
- C. It shall be possible to provide access to all Network Area Controllers via single connection to the server. In this configuration, each Network Area Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.

- D. The server shall provide the following functions, at a minimum:
1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
  2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.
  3. The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC).
  4. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
  5. The server shall provide scheduling for all Network Area Controllers and their underlying filed control devices.
  6. The server shall be capable of providing demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
  7. The server shall implement the Command Prioritization Scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers. Systems not employing this prioritization shall not be accepted.
  8. Each Network Area Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
  9. The server shall provide central alarm management for all Network Area Controllers supported by the server. Alarm management shall include:
    - a. Routing of alarms to display, printer, email, and pagers.
    - b. View and acknowledge alarms.
    - c. Query alarm logs based on user-defined parameters.
  10. The server shall provide central management of log data for all Network Area Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
    - a. Viewing and printing log data
    - b. Exporting log data to other software applications
    - c. Query log data based on user-defined parameters.

## 2.10 LIBRARY

- A. A Standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
- B. The objects in this library shall be capable of being copied and pasted into the user's data base and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
- C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) Library, available to all registered users to provide new or updated objects and applications as they are developed.
- D. All control objects shall conform to the control objects specified in the specification.
- E. The library shall include applications or objects for the following functions, at a minimum:

1. Scheduling Object. The schedule must conform to the schedule object as defined in the specification, providing 7 day plus holiday and temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
  2. Calendar Object. The calendar must conform to the calendar object as defined in the specification, providing 12 month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point and click" selection. This object must be linkable" to any or all scheduling objects for effective event control.
  3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals.
  4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling, etc.) to maintain occupant comfort or for equipment freeze protection.
  5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled unoccupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy saving. Provide automatic tuning of all start/stop time object properties based on the previous day's performance.
  6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the user's screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.
- F. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the specification.
1. Analog Object – Minimum requirement is to comply with the standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
  2. Analog Output Object – Minimum requirement is to comply with the standard for data sharing.
  3. Binary Input Object – Minimum requirement is to comply with the standard for data sharing. The user must be able to specify either input condition for alarming. This

- object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an “on” condition. The user must be able to specify either input condition as the “on” condition.
4. Binary Output Object – Minimum requirement is to comply with the BAC net standard for data sharing. Properties to enable minimum on and off time for equipment protection as well as interstart delay must be provided. The Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the method of contention resolution shall not be acceptable.
  5. PID Control Loop Object – Minimum requirement is to comply with the standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral, and derivative control.
  6. Comparison Object – Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked outputs. Also, allow limits to be applied to the output value for alarm generation.
  7. Math Object – Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
  8. Custom Programming Objects – Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.
  9. Interlock Object – Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after start-up to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.
  10. Temperature Override Object – Provide an object whose purpose is to provide the capability of overriding a binary output to an “On” state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the temperature override level of start/stop command priority unless changed by the user.
  11. Composite Object – Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the “contained” application that are represented on the graphical shell of this container.

- G. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). At a minimum, provide the following as part of the standard library included with the programming software:
1. LonMark/LonWorks devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide Lon Mark manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the LonMark profile shall be supported. Information (type and function) regarding network variables not defined in the LonMark profile shall be provided by the device manufacturer.
  2. For devices not confirming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file and documentation for the device to facilitate device integration.
  3. For devices, provide the following objects at a minimum:
    - a. Analog In
    - b. Analog Out
    - c. Analog Value
    - d. Binary
    - e. Binary In
    - f. Binary Out
    - g. Binary Value
    - h. Multi9-State In
    - i. Multi-State Out
    - j. Multi-State Value
    - k. Schedule Export
    - l. Calendar Export
    - m. Trend Export
    - n. Device
  4. For each object, provide the ability to assign the object a device and object instance number.
  5. For devices, provide the following support at a minimum.
    - a. Segmentation
    - b. Segmented Request
    - c. Segmented Response
    - d. Application Services
    - e. Read Property
    - f. Read Property Multiple
    - g. Write Property
    - h. Who-has
    - i. I-have
    - j. Who-is
    - k. I-am
    - l. Media Types
    - m. Ethernet
    - n. IP Annex J
    - o. MSTP
    - p. Broadcast Management Device (BBMD) function
    - q. Routing

Note: Depending on the project configuration and requirements, it may be desired to integrate data from devices that are not LonMark or. These could include industrial or plant floor devices such as PLC's. Because of the many drivers available, a common method of providing this integration is: Dynamic Data Exchange (DDE), MODBUS (DDEE), and Ole for Process Control (OPC).

## 2.11 NETWORK AREA CONTROLLER (NAC)/SYSTEM NETWORK CONTROLLER (SNC)

- A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC), and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
- B. The controllers must be fully programmable to meet the unique requirements of the facility it must control.
- C. The controllers must be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via modem, or connected via the Internet.
- D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4, TCP/IP and SNMP. Use of proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.
- E. The SNC shall be capable of executing application control programs to provide:
  - 1. Calendar functions
  - 2. Scheduling
  - 3. Trending
  - 4. Alarm monitoring and routing
  - 5. Time synchronization.
  - 6. Integration of LonWorks and ModBus controller data.
  - 7. Network management functions for all SNC, PEC and ASC based devices.
- F. The SNC must provide the following hardware features as a minimum:
  - 1. One Ethernet Port-10/100 Mdps
  - 2. One RS-232/485 port
  - 3. One LonWorks Interface Port – 78KB FTT-10A
  - 4. Battery Backup
  - 5. Flash memory for long term data backup (if battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
- G. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- H. The SNC shall provide alarm recognition, storage, routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
- I. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
  - 1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
    - a. Alarm
    - b. Return to normal



- c. To default
- 2. Alarms shall be annunciated in any of the following manners as defined by the user:
  - a. Screen message text
  - b. Email of complete alarm message to multiple recipients.
  - c. Pagers via paging services that initiate a page on receipt of email message.
  - d. Graphics with flashing alarm object(s).
- 3. The following shall be recorded by the SNC for each alarm (at a minimum):
  - a. Time and date.
  - b. Equipment (air handler #, accessway, etc.)
  - c. Acknowledge time, date, and user who issued acknowledgement.
- J. Programming software and all controller “Setup Wizards” shall be embedded into the SNC.
- K. Operator Touch Screen Interface  
Provide a color graphic display touch screen operator interface mounted on panel face as indicated on drawings. The Operator Touch Screen Interface shall serve as the user interface to the entire TCS and shall allow the monitoring and the control of all systems points without the use of a mouse or keyboard.  
Access to the system shall be permission-based, configurable permission access levels based on operator’s role.  
Information on the color graphic display shall be dynamic and automatically updated.

## 2.12 PROGRAMMABLE EQUIPMENT CONTROLLER (PEC)

- A. HVAC control shall be accomplished using LonMark™ based devices where the application has a LonMark™ profile defined. Where LonMark™ devices are not available for a particular application; devices based on LonMark™ shall be acceptable. For each LonWorks™ device that does not have LonMark™ certification, the device supplier must provide an XIF file for the device. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework™, that allow standard and customizable control solutions required in executing the “Sequence of Operation.”
- B. All PECs shall be application programmable and shall at all times maintain their LonMark™ certification. All control sequences within or programmed into the ILC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
- C. The PECs shall communicate with the SNC at a baud rate of not less than 78.8K baud. The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.
- D. The following integral and remote Inputs/Outputs shall be supported per each PEC:
  - 1. Four integral dry contact digital inputs.
  - 2. Six integral analog inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC).
  - 3. Three integral 4-20 ma analog outputs.
  - 4. Eight integral 24 Vac Triac digital outputs, configurable maintained or floating motor control outputs.
  - 5. One integral 20 Vdc, 65-mA power supply for auxiliary devices.
- E. Each PEC shall have expansion ability to support additional I/O requirements through the use of remote Input/Output modules.

## 2.13 APPLICATION SPECIFIC CONTROLLERS (ASC'S)

- A. Application Specific Controllers (ASC's) shall be standalone EEPROM based configured to perform the sequences specified, and with I/O selected for the application. All unitary DDC

controllers shall support the LonMark™ Functional Profile for the given application. ASCs shall be tested and listed under UL916 for computing devices. ASC enclosures shall be flame retardant compact plastic conforming to UL94-V5 for plenum mounting or plated steel. Each ASC shall be provided with face mounted LED type annunciation to continually display its operational mode: power, normal, or in an alarm state. As an alternative to the face mounted integral LED, the control contractor shall provide relay driven pilot lights mounted at the AC location, which shall provide the specified annunciation. ASCs shall be configured for DIN rail mounting using industry standard clip on adapters or direct panel mounted. The controller shall be programmable and configurable using Niagara 4 Framework™ and provide control solutions as required to executing the “Sequence of Operation.”

Input/Output Module

- a. Provide a remote Input/Output module that connects sensors and actuators onto the field bus network for use by the NAC, ILC and ASC DDC Controllers. I/O Device shall support LonMark standard network communication technology for controller-to-controller communications. I/O Device shall have extended operating temperature rating from -40F to +150F so Device can be mounted directly in wiring cabinet of monitored appliances.

## 2.14 ADVANCED UNITARY CONTROLLER

- A. The advanced unitary controller (AUC) platform shall be designed specifically to control HVAC – ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes: water service heat pumps, air handlers, heat pumps, natural convection units. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework™, that allows standard and customizable control solutions required in executing the “Sequence of Operation.”
- B. Minimum Requirements:
  1. The Controller shall be fully programmable with full functionality on any Niagara 4 brand platform.
    - a. Support downloads to the controller from any brand of Niagara 4 platform.
    - b. Support uploads from the controller to any brand of Niagara 4 platform.
    - c. Support simulation/debug mode of the controller.
    - d. Maintain native GUI.
    - e. Native function-block programming within the Niagara 4 environment.
  2. The controller shall be capable of either integrating with other devices or standalone operation.
  3. The controller shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for network communications. Controller memory minimum requirements include:
    - a. FLASH Memory Capacity: 60 Kilobytes with 8 Kilobytes for application program.
    - b. FLASH Memory settings retained for ten years.
    - c. RAM: 2 Kilobytes.
  4. The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.
  5. The controller shall have an internal time with the ability to automatically revert from a master time clock on failure.
    - a. Operating Range: 24 hours, 365 days, multi-year-calendar including day of

- week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
- b. Accuracy: +/- minute per month at 77° F (25° C).
  - c. Power Failure Backup: 24 hours at 32° to 122° F (0° to 50° C).
6. The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
  7. The controller shall have an internal DC power supply to power external sensors.
    - a. Power Output: 20 VDC +/- 10% at 75 Ma
  8. The controller shall have visual indication (LED) of the status of the device:
    - a. Controller operating normally.
    - b. Controller in process of download.
    - c. Controller in manual mode under control of software tool.
    - d. Controller lost its configuration.
    - e. Now power to controller, low voltage, or controller damage.
    - f. Processor and/or controller are not operating.
  9. The minimum controller Environmental ratings:
    - a. Operating Temperature Ambient Rating: -40° to 150° F (-40 to 65.5° C).
    - b. Storage Temperature Ambient Rating: -40° to 150° F (-40 to 65.5° C).
    - c. Relative Humidity: 5% to 95% non-condensing.
  10. The controller shall have the additional approval requirements, listings, and approvals:
    - a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
    - b. CSA (LR95329-3) Listed
    - c. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
    - d. Meets Canadian standard C108.8 (radiated emissions).
    - e. Conforms requirements European Consortium standard EN 61000-6-1; 2001 (EU Immunity)
    - f. Conforms requirements European Consortium standard EN 61000-6-3; 2001 (EU Emission)
  11. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35 mm).
  12. The controller housing shall have a mix of digital inputs (DI), digital Triac Outputs (DO), analog outputs and universal inputs (UI).
    - a. Analog outputs (AO) shall be capable of being configured as digital outputs (DO).
    - b. Input and Output wiring terminals shall be removable from the controller without disconnecting the wiring.
    - c. Input and Output wiring terminals shall be designated with color coded labels.
    - d. Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20mA).
  13. The controller shall provide for "user defined" Network Variables (NV) for customized configurations and naming using Niagara 4 Framework™.
  14. The controller shall provide "continuous" automated loop tuning with Adaptive Integral Algorithm Control Loop.
  15. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section four.

- a. Discharge air control and low limit.
- b. Pressure-dependent dual duct without flow mixing.
- c. Variable air volume with return flow tracking.
- d. Economizer with differential enthalpy.
- e. Minimum airflow coordinated with CO2.
- f. Unit ventilator cycle (1, 2, 3) 2-pipe.
- g. Unit ventilator cycle (1, 2, 3) 2-pipe with face/bypass
- h. Unit ventilator cycle (1, 2, 3) 4-pipe.
- i. Unit ventilator cycle (1, 2, 3) 4-pipe with EOC valve.

## 2.15 VARIABLE FREQUENCY DRIVES

- A. The VFD shall generate the required variable frequency through three main input voltage lines connected to a coil capacitor LC filter and diode bridge. This shall produce a DC voltage for an insulated gate bi-polar transistor (BGT) bridge. The IGBT bridge shall produce a pulse-width modulated (PWM) AC voltage for the motor. A microprocessor shall control the motor according to measured signals and control commands set from the VFD control panel. Control commands may be provided by stand-alone sensor input or by output from a DDC building management system.
  - 1. Integral power supply shall be one of the following as required by each motor:
    - a. 200-240 VAC, 3 phase, 45-66 Hz  $\pm$  10%
    - b. 380-500 VAC, 3 phase, 45-66 Hz  $\pm$ 10%
    - c. 525-690 VAC, 3 phase, 45-66 Hz  $\pm$  10%
  - 2. The ambient ratings and temperature ranges shall:
    - a. Operating 14°F to 104°F (-10°C to 40°C)
    - b. Storage: -40°F to 104°F (-40°C to 60°C)
    - c. Humidity range: 5 to 95% RH, non-condensing
- B. The Enclosure shall be rated NEMA 1.
- C. The VFD shall be RoHS compliant. The VFD will not contain electrolytic capacitors. The VFD circuit shall be lead-free.
- D. All Variable Frequency Drives shall have the following standard features:
  - 1. The VFD shall have Pump and Fan Startup Wizards that can be modified using a personal computer-based commissioning tool with an optional software package, or a field removable control panel. The graphic display shall be removable for separate mounting, a minimum of 45 feet away from the VFD.
  - 2. The VFD shall log and display as a minimum, without adding separate instruments or equipment, the following:
    - a. Temperature of the heat sink.
    - b. Motor temperature
    - c. Output frequency
    - d. Status of analog and digital inputs and outputs
    - e. Motor speed in rpm
    - f. Total kWh consumed
    - g. Total kWh trip counter
    - h. Total kWh run counter
    - i. Total hours run.
  - 3. The VFD shall be UL, cUL, and CE approved.
  - 4. The VFD shall be provided with built-in RFI filters and all models 3 HP or more shall include a DC or AC Choke.

5. The VFD shall have the capability of communicating with over the following protocols:
  - a. /MSTP and /IP
  - b. LonBus
  - c. Modbus RTU and Modbus/TCP
  - d. N2
6. The VFD shall accept a 0-10 Vdc or 4-20 mA signal, as well as six programmable digital inputs.
7. The VFD shall have a real-time clock for timed functions.
8. The VFD shall include a minimum of two programmable output relays, to provide signals such as run, ready or fault. It shall also include one 4-20 mA or 0-20 mA programmable output to provide signals such as motor speed, output frequency, or any other selected information.
9. The VFD shall include a Proportional + Integral + Derivative (PID) controller as standard to provide closed loop control directly from a signal transmitter without the need for external signal conditioning.
- E. The VFD shall have the ability to be placed into Panel Control mode. In the panel control mode, the operator shall have the ability to enter a speed reference into the display to control the speed of the motor.
- F. The VFD shall have sufficient capacity and provide a quality waveform so as to achieve full output power of the motor without causing excessive additional heat rise.
  1. The minimum efficiency of the drive shall be:
    - a. >96% at 100% load
    - b. >92% at 20% load
- G. The VFD shall comply with the following EMC standards:
  1. Immunity: EN50082-1, -2, EN61800-3
  2. Emission: EN50081-1, -2, EN61800-3
- H. Output frequency range of 0-320 Hz with a resolution of 0.01 Hz
  1. It shall be possible to set switching frequency within the range of 3 kHz to 16 kHz to minimize audible motor noise.
- I. A minimum of 8 preset motor speeds shall be available.
- J. The VFD shall provide 3 skip frequencies with lower and upper frequency set-points to avoid mechanical resonance.
- K. The VFD shall protect itself against:
  1. Input transients to VDEO160 class W2
  2. Loss of motor phase
  3. Grounding of any output phase
  4. Loss of speed reference.
- L. The VFD shall have an input for a motor thermistor to monitor motor temperature. If a motor thermistor is not connected, the VFD shall model the motor temperature in its software. When overheating of the motor is predicted, an alarm or automatic shutdown shall be initiated.
- M. The VFD shall provide full electrical isolation between power and control components, including input and output signals.
- N. The VFD shall have the following protection functions:
  1. Heat sink over-temperature.
  2. Under-voltage protection.
  3. Over-voltage protection.
  4. Over-current protection

5. Earth fault protection
  6. VFD fault protection
  7. Loss of input/output phase protection
  8. Motor stalled protection
  9. Motor under-load protection
  10. Motor over-temperature protection
  11. Short circuit protection
  12. External fault injection
- O. The VFD shall consist of separate modules for the control section, power section, and fan. Each section shall consist of separate modules for the control section, power section, and fan. Each section shall be able to be removed and replaced independent of the other sections.
- P. The entire power section must be in a steel enclosure. No other enclosures are acceptable.
- Q. The control unit section of the VFD shall have the ability to be powered by an external 24 Vdc power supply to allow access to the stored data and to allow for: commissioning, field bus applications, and checkout prior to connecting the main supply.
- R. The VFD control panel shall display at least five run status indicators, including:
1. Run
  2. Ready
  3. Fault
  4. Motor Direction
  5. Stop
- S. The VFD control panel shall have the ability to monitor at least 9 real-time actual values or parameters.
- T. The control panel shall allow the user to lock out parameters by choice of a password or parameter selection.
- U. The control panel shall have EEPROM to retain all parameters when the VFD is powered down.
- V. The control panel shall show, on a fault condition, the following information:
1. Operation days
  2. Operation hours
  3. Output frequency
  4. Motor current
  5. Motor voltage
  6. Motor Power
  7. Motor Torque
  8. DC Voltage
  9. Unit Temperature
  10. Run Status
- W. Software
1. The VFD Manufacturer shall offer the following software, at no additional charge or license fee:
    - a. VFD commissioning software
    - b. Updated versions of VFD system software
    - c. Updated versions of VFD applications software
    - d. Updated versions of VFD option board software
- X. Installation

The VFD shall be installed by the Mechanical Contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer, as outlined in the installation manual.

The VFD power wiring shall be completed by the electrical contractor. The contractor shall complete all power wiring in accordance with wiring recommendations of the VFD manufacturer, as outlined in the installation manual.

- Y. Warranty
- Z. All VFD components, parts and assemblies shall be guaranteed against defects in materials and workmanship for 36 months.
- AA. VFD to be LON and open protocol.
- BB. Manufacturer: ABB

## 2.16 ENERGY ANALYSIS AND MANAGEMENT SYSTEM SOFTWARE

- A. Operating System: The Energy Suite shall run Windows 10 or latest version or utilize Niagara 4 Analytics 2.0 framework (Niagara 4 Supervisor).
- B. The Energy Suite shall employ browser-based functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) allowing users to view and manipulate underlying systems without the need for dedicated workstations or client software. In addition, menu-pull downs, and toolbars shall employ buttons, commands, and navigation to permit the user access to real-time analysis, computations, and reports with a minimum knowledge and basic computing skills.
- C. The Energy Suite shall support, as needed, unlimited point and meter capacity.
- D. The Energy Suite shall provide a comprehensive M&V Tool that meets International Performance Measurement and Verification Protocol (IPMVP) guidelines.
- E. Energy and Enterprise Profiler. The profile shall provide extensive reporting flexibility allowing users to profile any data point over any period of time. The user shall be able to trend and analyze energy, temperature, production, and facility data with, at a minimum, the following reports:
- F. Aggregation Analysis. Compute's consumption and demand along with load factor for a point or group of points.
- G. Average Daily Profile. Displays an average 24 hour period for any day or combination of days.
- H. Enterprise Ranking. Ranks energy usage in the enterprise to identify the most and least efficient buildings.
- I. Equipment Operation. Displays runtime and runtime percentage for digital points.
- J. Exceptions. Allows user to compare data values versus a baseline or against a defined range of values.
- K. Load Duration. Identifies the length of time that a demand exceeds a certain level.

- L. Point Trending. Performs statistical analysis to determine correlations, standard deviations, slope, regression line, and mean.
- M. Relative Contribution. Determines how sub meters or multiple main meters contribute to total energy within or between sites.
- N. Spectrum Summary. Utilizes pattern recognition to quickly identify anomalies with inconsistent patterns indicating a need for more detail analysis.
- O. Correlation. Shows the correlation between two data logs to determine if any relationship exists between them.
- P. Cost Profiler. The profile shall provide extensive reporting flexibility allowing users to compare energy costs based on metered interval data and applicable rate structures. The user shall be able to benchmark facilities, identify inefficiencies, implement changes, and measure the cost impact of energy reduction strategies to proactively manage budgets and calculate accurate cost projections. In addition, the user shall be able to compare different procurement strategies and rate structures without actually switching energy providers or rates. Provide at a minimum the following reports:
- Q. Bill Reconciliation. Compare utility invoices to calculated values to identify billing errors. User can establish a historical baseline with manually entered date from utility invoices.
- R. Cost Contribution. Determine how meters, whether sub meters within a building or main meter across an enterprise, contribute to the aggregate energy expense.
- S. Cost Ranking. Ranks meters to determine the most costly. Normalize data based on outside air temperature and floor area.
- T. Budget Report. User can enter budgets or use historically generated data, then compare against actual costs and make projections for reporting periods.
- U. What-If Analyzer. Enables prediction of future costs. User can manipulate consumption patterns and demand levels to project savings from various strategies.
- V. Rate Comparison. Analyze alternative rates and energy providers. Determine the effect of an energy strategy prior to implementation.

## 2.17 OTHER CONTROL SYSTEM HARDWARE

- A. Motorized control dampers that are not be integral to the equipment shall be furnished and installed by the Mechanical Contractor/ATC Contractor. Control damper frames shall be constructed of galvanized, steel, formed into changes and welded or riveted. Dampers shall be galvanized, with nylon bearings. Blade edge seals shall be vinyl. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-guage minimum and 6 inches wide maximum and frame shall be of welded channel iron. Bearings shall be composed of a Celcon inner bearing with aluminum hexagon blade pivot pin, rotating within a poly carbonate outer bearing inserted in the frame. The dampers shall be equal to Tamco series 9000 ECT



- for parallel blade dampers and for opposed blade dampers. Dampers shall have a closed leakage rate of not more than 1.4 CFM per sq. ft. for 3'x3' damper at 1" S.P leakage class 1A.
- B. Control damper actuators shall be furnished by the ACT Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators. All damper actuators (motors) installed in conjunction with an Air Handler/HVAC unit must be of the spring return, 2 position, occupied/unoccupied type, or modulating where an economizer cycle is required. Combustion air damper actuators shall be of the 2 position, spring return type.
- C. Control Valves: Control valves shall be 2-way, or 3-way pattern as shown and constructed for tight shutoff at the pump shut-off head or steam relief valve pressure. Control valves shall operate satisfactorily against system pressures and differentials. Two position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop for a maximum pressure drop of 5.0 psi at rated flow (unless otherwise noted or scheduled on the drawings). Valves with sizes up to and including 2 inches shall be "screwed" configuration and 2-1/2 inch and larger valves shall be "flanged" configuration. All control valves, including terminal unit valves, less than 2 inches shall be globe valves. Electrically actuated control valves shall include spring return type actuators sized for tight shut-off against system pressures (as specified above) and, when specified, shall be furnished with integral switches for indication of valve position (open-closed).
- D. Control Valve Actuators: Actuators for VAV terminal unit heating coils shall be "drive-closed" type. All actuators shall have inherent current limiting motor protection. Valve actuators shall be 24-volt, electronic type, modulating or two-position as required for the correct operating sequence. Actuators on valves needing 'fail-safe' operation shall have spring return to Normal position. Modulating valves shall be positive positioning in response to the signal. All valve actuators shall be UL listed.
- E. All control valves 2 1/2" or larger shall have position indication. All hot water control valves shall be Normally-Open arrangement; all chilled water control valves shall be Normally-Closed arrangement.
- F. Dynamic Pressure-Regulating Control Valves
- G. The valve and actuator combination product family shall be a factory assembled and tested unit.
- H. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F. The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees, F., over the entire range.
- I. Duct-mounted and Outside Air Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of  $\pm 0.2^{\circ}\text{C}$ . Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F. The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 – foot

- long sensor element. These devices shall have accuracy of 0.5 degrees F, over the entire range.
- J. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 – 30 VDC input voltage, analog output (0-10 VDC or – 20 mA output). Operating range shall be 0 to 100% RH and 32 59 140-degree F. Sensors shall be selected for wall, duct, or outdoor type installation as appropriate.
  - K. Carbon Dioxide Sensors (CO<sub>2</sub>): Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.), repeatable to plus or minus five percent (5%) or 75 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 – 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure.
  - L. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.
  - M. Differential Analog (duct) Static Pressure Transmitters provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube.
  - N. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips. +1-5% accuracy, 1" to 1" P.G.
  - O. Water Flow Switches: Provide a SPST type contact switch with bronze paddle blade, size for the actual pipe size at the location. If installed outdoors, provide a NEMA-4 enclosure. Flow switch shall be UL listed.
  - P. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BAS in a UL-Certified 508A panel shop. A complete set of 'as-built' control drawings (relating to the controls within the panel) shall be furnished within each control panel.
  - Q. Pipe and Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with and accuracy of  $\pm 1\%$  accuracy. Their range shall be -5 to 250°F. Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included.
  - R. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F., range, and vapor-charged temperature sensor. Honeywell model L482A, or approved equivalent.
  - S. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a subbase and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.
  - T. Emergency Stop Switches: Provide toggle-type switch with normally-closed contact. Switch shall be labeled "AIR HANDLER EMERGENCY SHUTOFF, NORMAL – OFF."
  - U. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit shall be designed to operate in the pressure ranges involved.
  - V. Control Power Transformers: Provide step-down transformers for all DDC controllers and

devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL Listed Class 2 type, for 120VAC/24VAC operation.

- W. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 149, IEEE C62.41B A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

## 2.18 ECONOMIZER

- A. HVAC units shall be provided with economizer controls where indicated on the drawings or elsewhere in these specifications or on any system 4 tons or over. Enthalpy selection system shall consist of one enthalpy transmitter in the outside air, one enthalpy transmitter in the return air, and a relay to select the lower of the two enthalpies. In operation, the signal from the two enthalpy transmitters shall be compared by the differential switching relay so that when the outside air enthalpy is lower than the return air enthalpy, the temperature control system shall modulate the outside, return, and relief dampers to supply up to 100% outside air for "free cooling". When the outside air enthalpy is higher than the return air, the system shall position to minimum outside air. The use of separate temperature and humidity transmitters to arrive at enthalpy is not acceptable. Outside air transmitter shall not be damaged by operation during fog conditions.
- B. The economizer module shall be ASHRAE 90.1 compliant (latest version).
- C. The module shall have a local display screen for diagnostics at the unit.
- D. On projects with building automation systems the economizer shall have a BACNET output and shall be interconnected to the building automation system.
- E. The module shall have fault detection diagnostics.
- F. Manufacturer: Belimo Zip Economizer series. Equal by Honeywell.

## 2.19 CONTROL DEVICES

- A. All electrical wiring for the control system shall be as specified in this section and the Electrical Section of the Specifications and as required by local codes. The wiring shall be by this contractor.
- B. Electric thermostats shall be low-voltage, modulating type to control modulating devices, or low- or line-voltage type with heat anticipator for two-position controls. Provide locking covers (clear plastic, hinged type).

## 2.20 DUCT SMOKE DETECTORS

- A. Duct smoke detectors shall be of the photo-electronic type with sampling tube of ample length to traverse the entire width of the duct. Duct smoke detectors shall be manufactured by the control companies, the fire alarm companies, B.R.K. Electronics or approved equal. All HVAC units of 2000 CFM or more shall have duct smoke detectors in both the supply and return air streams. A single duct smoke detection in the return air stream shall be provided only when acceptable to the local authority having jurisdiction.
- B. Duct smoke detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
- C. Units of 15,000 CFM or more shall have two detectors. (supply and return air)
- D. Furnish and install where indicated on the drawings or required elsewhere in the

specifications air duct smoke detectors. They shall integrate photoelectric, ionization and heat sensing technologies for optimum detection accuracy and to prevent unwanted alarms. Auxiliary contacts shall be provided to shut down the air handling unit fan. The detector shall output to a remote alarm indicator.

- E. Duct smoke detectors to be furnished by the electrical contractor.
- F. Duct smoke detectors shall be installed by the mechanical contractor.
- G. Interconnection between the duct smoke detectors and fire alarm system shall be performed by the electrical contractor/fire alarm contractor.
- H. Control's integration to shut down the HVAC equipment in alarm shall be performed by the mechanical contractor/ATC contractor.

#### 2.21 FREEZESTATS

- A. The freezestat shall be of the vapor pressure type with a 20 foot minimum element. Element shall respond to the lowest temperature sensed by any one foot section.
- B. The freezestat shall be manual reset. Provide reset button and red indicator light. Location to be coordinated with architect.
- C. All coils (heating hot water, chilled water, condenser water/water source) with outside air and hot water in ducts or units shall have freezestats.

### PART 3 - EXECUTION

#### 3.01 SUBMITTALS

- A. The materials, equipment and software design shall be submitted as follows:
  - 1. Submittals to include but not limited to:
    - a. Submit shop drawings of all components.
    - b. Submit manufacturers' data sheets of valve Cv performance.
    - c. Submit design data and sequence of operations descriptions for all systems.
    - d. Submit wiring diagrams of electrical or electronic control systems.
    - e. ATC Contractor to include all input and output points for engineer review and approval.
    - f. At the completion of the project, submit final "as-built" drawings/CAD disk, all associated component/equipment cut-sheets/submittals, wiring diagrams, and final/actual sequence of operations descriptions of each system. Include ATC emergency contact information.
  - 2. Ten copies of shop drawings or the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions, samples of written controller checkout sheets and performance verification procedures for applications similar in scope shall be included for approval.
  - 3. Shop drawings shall also contain complete wiring I/O point list for each system, schematic diagrams, sequences of operations, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Shop drawings shall be approved before any equipment is installed. Please allow 10 days for submission, review and return by engineer.
  - 4. All dampers and actuator valves and actuator shall be sized and submitted with shop

- drawing. Schedule shall include:
- a. Identification tag all dampers/valves.
  - b. Location all damper/valves.
  - c. Damper and/or Valve type.
  - d. Actuator size and type.
  - e. Damper and/or valve pressure drop.
5. Submittal shall also a "sample of prior art" for project of the graphics. This web-based interface with the network via dynamic color shall include a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation.
- a. Minimum depiction for graphics for project:
  - b. Building picture and site plot plan (aerial or ground view provided by owner).
  - c. Building floor plan.
  - d. Each mechanical system.
  - e. Control devices depicted by point-and-click graphics.

Note:

Floor plan shall indicate each mechanical zone with different colors shaded as required to depict which zones are not maintaining temperature/humidity/pressure/CO<sub>2</sub>, etc programmable levels/limits and which zones are in alarm.

Provide animated graphic for each system component including rooftop units, air handling units, UAV terminals, fan powered terminals, exhaust fans, supply fans, hot water systems – boilers, hot water pumps; chilled water systems – chillers, cold water pump condenser water pumps, cooling towers, etc.

The graphics are intended to be 20% - 30% complete at this stage with changes to be based on review comments from the engineer and/or owner.

- B. Upon completion of the work, provide a complete set of as-built drawings on compact disk (CD). Additionally, all control device furnished with this section shall be programmable directly from Tridium N4™ workbench.
- C. Upon completion of this project, the following copies of software shall be included on CD for the owner:
  1. The ATC contractor shall use the "contract CD to owner – software package" to simulate all software application programs to ensure such programs are free from design errors and they accurately accomplish the application(s) sequence-of-operation. This simulation shall include the WEBS-N4™ embedded tool in controller allowing for the capability of other Niagara 4 factory certified contractor(s) access to the programming capability. The simulation shall be demonstrated before the owner/engineer at time and place arranged by the owner. Allow for a minimum of (8) hours for the demonstration and software changes resulting from the demonstration the owner feels should be changed/enhanced, etc. will/may result in another demonstration if so requested by owner. These changes will be made at no additional expense to owner.
  2. Four copies of the "as-built" drawings shall be provided in addition to the document on compact disk. All "as-built" drawings shall also be installed into the BAS server in a dedicated directory. For each JACE™ (WEBS-N4™) the station shall be copied to supervisor and distribution file copy back-up and written to CD to owners' hands.
  3. Control contractor shall provide "quote" to owner to install mechanical equipment service information such as, spare parts list, mechanical service contractors, etc into

FMCS server as a dedicated directory. Owner, working with engineer, shall develop specification requirements for control contractor. ATC contractor shall include (8) hours of technical support, including updating information as requested by owner, covering the time interval of the warranty period.

### 3.02 INSTALLATION

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Line and low voltage electrical connections to control equipment show specified or show on the control diagrams shall be furnished and installed by the ATC Contractor in accordance with these specifications.
- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the ATC Contractor (ATC Contractor to coordinate with the Mechanical Contractor).
- D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic label.
- E. Installation of Network
  - 1. Ethernet
    - a. The network shall employ Ethernet LAN architecture, as defined by IEEE 802.3. The Network Interface shall be fully Internet Protocol (IP) compliant allowing connection to currently installed IEEE 802.3, Compliant Ethernet Networks.
    - b. The network shall directly support connectivity to a variety of cabling types. As a minimum provide the following connectivity: 10 Base 2 (ThinNet RG-58 A/U Coaxial cabling with BNC connectors, 10 Base T (Twisted-Pair-RJ-45 terminated UTP cabling).
  - 2. LonWorks
    - a. The network shall employ LonTalk communications FTT-10.
  - 3. MS/TP
    - a. The network shall employ MS/TP EIA-485-A Standard.
    - b. The MS/TP EIA-485 network shall use shielded, twisted-pair cable with a characteristic impedance between 100 and 130 ohms.
  - 4. Third Party Interfaces: Contractor shall integrate real-time data from building systems by other trades and databases originating from other manufacturers as specified and required to make the system work as one system.
- F. Installation of Digital Controllers and Programming
  - 1. Provide a separate digital control panel for each major piece of equipment, such as air handling unit, chiller, pumping unit etc. Points used for control loop reset such as outdoor air, outdoor humidity, or space temperature could be located on any of the remote control units.
  - 2. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25 percent of available memory free for future use.
  - 3. System point names shall be modular in design, permitting easy operator interface without the use of a written point index.
  - 4. Provide software programming for the applications intended for the systems specified and adhere to the strategy algorithms provided.

5. Provide graphics for each piece of equipment and floor plan in the building. This includes each chiller, cooling tower, air handling unit, fan, terminal unit, boiler, pumping unit etc. These graphics shall show all points dynamically as specified in the point list.

### 3.03 WIRING

- A. All wiring to be CAT 6 plenum rated in concealed areas and in conduit where exposed or subject to damage. All exterior exposed control wiring to be in conduit and weather protected. Conduit to be EMT or galvanized. No PVC is permitted in plenum.
- B. All control wiring and power wiring to the control panels, NAC, computers, and network components shall be the responsibility of the ATC contractor.
- C. All wiring shall be in accordance with the National Electrical Code and any applicable local codes. All wiring shall be installed in the conduit types specified unless otherwise allowed by the National Electrical Code or applicable local codes.

### 3.04 START UP

- A. The ATC contractor shall verify that all wiring is properly connected and free of all shorts and ground faults. Verify that all connections are tightened appropriately. Calibrate each device as required by the manufacturer's recommendations.
- B. Verify that the digital output devices operate properly and that the normal positions are correct.
- C. Verify that all analog output devices are functional, that start point and span are correct, and that direction and normal positions are correct including fail-safe positions. The ATC contractor shall check all control valves and automatic dampers to ensure proper action and closure. The ATC contractor shall make any necessary adjustment to valve stem and damper blade travel.
- D. Complete software shall be installed and tested (dry run) prior to start-up.
- E. Software technician shall observe and fine tune all control loops.
- F. Alarms and interlocks:
  1. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
  2. Interlocks shall be tripped using field contracts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
- G. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
- H. Return the system to a normal operating state after each phase of start-up, commissioning, and demonstration. Any points overridden, devices placed in manual position, setpoint adjusted, etc. are to be restored to normal operation condition prior to acceptance.
- I. Connection to the Internet must be tested and communication confirmed.

### 3.05 SYSTEM VALIDATION AND DEMONSTRATION

- A. As part of final system acceptance, a system demonstration is required (see below). Prior to start of this demonstration, the ATC contractor is to perform a complete validation of all aspects of the Controls and Instrumentation System.
- B. Validation
  1. Prepare and submit for approval a Validation Test Plan including Test Procedures for

the performance verification tests. Test Plan shall address all specified functions of the Engineering Control Center and all specified sequences of operation. Explain in detail actions and expected results used to demonstrate compliance with the requirements of this specification. Explain the method for simulating the necessary conditions of operation used to demonstrate performance of the system. Test plan shall include a Test Check List to be used by the Installer's agent to check and initial that each test has been successfully completed. Deliver Test Plan documentation for the performance verification tests to the Architect or Owner's Representative, 30 calendar days prior to start of performance verification tests. Provide draft copy of operation and maintenance manual with performance verification test.

2. After approval of the Validation Test Plan, Installer shall carry out all tests and procedures therein. Installer shall completely check out, calibrate, and test all connected hardware and software to insure that system performs in accordance with approved specifications and sequences of operation submitted. Installer shall complete and submit Test Check List

C. Demonstration

1. System operation and calibration to be demonstrated by the ATC Contractor in the presence of the Engineer, Architect or Owner's representative on random samples of equipment as dictated by the Owner's representative. Should random sampling indicate improper commissioning, the owner reserves the right to subsequently witness complete calibration of the system at no additional cost to the owner.
2. Demonstrate to authorities that all required safeties and life safety functions are fully functional and complete.
3. Make accessible personnel to provide necessary adjustments and corrections to systems as directed by balancing agency.
4. Witnessed validation demonstration of Operator's Terminal functions shall consist of:
  - a. Running each specified report.
  - b. Display and demonstrate each data entry to show site specific customizing capability. Demonstrate parameter changes.
  - c. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
  - d. Execute digital and analog commands in graphic mode.
  - e. Demonstrate DDC loop precision and stability via trend logs of inputs and outputs 6 loops minimum.
  - f. Demonstrate BAS performance via trend logs and command trace.
  - g. Demonstrate scan, update, and alarm responsiveness.
  - h. Demonstrate spreadsheet/curve plot software, and its integration with database.
  - i. Demonstrate on-line user guide, and help function and mail facility.
  - j. Demonstrate digital system configuration graphics with interactive upline and downline load, and demonstrate specified diagnostics.
  - k. Demonstrate multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
  - l. Demonstrate class programming with point options of beep duration, beep rate, alarm archiving, and color banding.

3.06 PROJECT CLOSEOUT - ACCEPTANCE TESTING

- A. Upon completion of the installation, the BAS Contractor shall load all system software and



start-up system. The ATC Contractor shall perform all necessary calibration, testing and debugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

- B. System Acceptance: Satisfactory completion is when the ATC Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

### 3.07 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the ATC Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software, and accessories.
- B. The BAS Contractor shall provide 8 hours of comprehensive training in three separate sessions (24 hours total) for system orientation, product maintenance and troubleshooting, programming, and engineering, if not provided under a previous contract at the site using the same brand and type of controllers within the previous 3 years.
- B. The ATC Contractor shall provide two (2, 4, 8 hour) training sessions for systems orientation, product maintenance, trouble shooting, and emergency contacts. ATC Contractor to coordinate with owner/architect/engineer to determine representatives/designated staff to be present for the training. ATC Contractor to provide one training session during the heating (winter) season and one during the cooling (summer) season.
- C. Train the designated staff or representative to enable them to do the following:
1. Day-to-Day Operations:
    - a. Proficiently operate the system.
    - b. Understand control system architecture and configuration.
    - c. Understand BAS system components.
    - d. Understand system operation, including BAS system control and optimizing routines (algorithms).
    - e. Operate the workstation and peripherals.
    - f. Log on and off the system.
    - g. Access graphics, point reports, and logs.
    - h. Adjust and change system set points, time schedule, and holiday schedules.
    - i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
    - j. Understand system drawings and Operation and Maintenance Manuals.
    - k. Understand job layout and location of control components.
    - l. Access data from BAS controllers and application specific controllers.
    - m. Operate portable operator terminals.
  2. Advanced Operators:
    - a. Make and change graphics on the workstation.
    - b. Create, delete, and modify alarms, including annunciation and routing of these.
    - c. Create, delete, and modify point trend logs and graphic or print these both on an ad-hoc basis and at user-definable intervals.
    - d. Create, delete, and modify reports.

- e. Perform BAS system field checkout procedures.
  - f. Perform BAS controller unit operation and maintenance procedures.
  - g. Perform workstation and peripheral operation and maintenance procedures.
  - h. Perform BAS diagnostic procedures.
  - i. Configure hardware including PC boards, switches, communication, and I/O points.
  - j. Adjust, calibrate, and replace system components.
3. System Managers/Administrators
- a. Interface with job-specific, third party operator software.
  - b. Add new users and understand password procedures.
- D. Sessions shall be scheduled so that at least one training session shall occur during heating season and one during cooling season.

### 3.08 WARRANTY PERIOD SERVICES

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance by owner.
- B. Within this period, upon notice by the Owner, any defects in the BAS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the ATC Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The ATC Contractor shall maintain all software during the warranty period. In addition, all factory or sub-vendor upgrades to software shall be added to the systems, when they become available, at no additional cost. New products are not considered upgrades in this context.
- D. Maintenance of Control Hardware: The ATC Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The ATC Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work and description of the corrective actions taken. The report shall clearly certify that all software and equipment/systems are functioning correctly.
- E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

### 3.09 WARRANTY ACCESS: Verify with owner(s) and/or IT representative on the model of service access into your BAS system for the warranty period. This access shall cover diagnostics and troubleshooting.

- A. The Owner shall grant to the ATC Contractor reasonable access to the BAS during the warranty period. Remote access to the BAS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

### 3.10 OPERATION & MAINTENANCE MANUALS

- A. See Part 1 and Part 3 for requirements. O&M manuals shall include the following elements, as a minimum.
  - 1. As-built control drawings for all equipment.
  - 2. As-built Network Communication Diagram.

3. General description and specifications for all components.
4. Completed Performance Verification Sheets.
5. Completed Controller Checkout/Calibration sheets.
6. (1) Copy of "Owner's CD" as specified in Section 23 00 00.
7. All equipment manufacturers/suppliers shall provide in writing (and documented if requested by the Owner) a NICS statement indication the interface with their equipment has no connectivity restrictions.
8. Niagara 4 JACE start up form must be submitted for each JACE provided. This is to include:
  - a. TCP/IP Settings
  - b. Platform Credentials
  - c. Administration level station access credentials
  - d. Installed version number.
  - e. Licensed version number.
  - f. Model, serial, and Host ID.

The station and tool "NICS" would be as follows:

Property	Value
Station Compatibility In	All
Station Compatibility Out	All
Total Compatibility In	All
Total Compatibility Out	All

## PART 4 - SEQUENCE OF OPERATIONS

### 4.01 GENERAL NOTES

- A. The mechanical contractor shall retain a qualified ATC sub-contractor to furnish all labor, materials, equipment, and service necessary for a complete and operating ATC system, utilizing direct digital controls (DDC) as shown on the drawings and described herein. The BAS shall provide standalone access using a standard web browser, HVAC system control, energy management, alarming, monitoring, trending and reporting functions with operator interface. The BAS shall include a web-based operator interface depict each mechanical system and building floor plan by a point-and-click graphic. The web server shall reside on the building owner's network and shall be provided with an IP address by the owner. The web server shall gather data from the mechanical systems and generate web pages accessible through a conventional web browser on each pc connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
- B. The BAS system shall provide:
  1. Stand-alone independent control for all mechanical systems as described in the sections that follow.
  2. Complete energy management software and firmware that resides and executes in networked field controllers. Operator workstation software shall not be utilized for energy management execution.
  3. Alarm management capability for all mechanical equipment described in the sections

- that follow – including alarm occurrence, annunciation, remote dial-out to remote sites or pagers, acknowledgement, problem diagnostics, and reporting functions.
4. Complete password protected system monitoring through a local networked operator workstation, or through remote operator workstations. Remote workstations shall utilize telephone or internet or ethernet communications links, as required.
  5. Standard and customized manual or automatic reports of trends, runtimes, consumables, alarms, and system operator activities.
  6. The ATC contractor shall provide one central “master” manual shutdown switch to serve all of the mechanical equipment that is connected to the building automation system. The shutdown switch shall be located where directed by the local code official (near a main entrance). The ATC contractor shall provide all associated control wiring, programming, and a break-glass pushbutton manual shutdown switch. The switch shall be labelled "HVAC emergency shut-down". (verify with the fire marshal. Emergency shut-down switch may need to be located in fire command panel. Coordinate with the electrical contractor).
  7. The mechanical contractor shall submit equipment submittals of all mechanical equipment to the ATC contractor for review prior to ordering the equipment.
  8. BAS web controllers and main control panel shall be connected to 120v emergency power provided by the electrical contractor.
  9. All ATC wiring, components and installation shall comply with the national electric code.
  10. ATC contractor shall utilize low voltage conductors (solid or stranded) of the appropriate gauge and approved by the thermostat manufacturer.
  11. All occupied, unoccupied and morning warm-up periods and all temperature set points for all spaces and systems, shall be defined by the BAS and be fully adjustable.

#### 4.02 EXISTING INDOOR VAV AIR HANDLING UNITS WITH CHILLED WATER COOLING AND STEAM HEAT

##### A. General

1. Air handling unit shall continue to operate under its current controls, until it gets replaced with a new VAV AHU with chilled water and hot water heating, integrated into the new BAS system

##### B. Operation

1. The supply fan shall operate continuously in occupied hours and cycle in unoccupied hours/evening hours. The supply fan shall operate continuously and the supply fan VFD shall vary the fan speed in response to a signal from the supply duct mounted pressure sensor.
2. Ventilation air - during occupied hours, the outside air damper shall be open. During the evening hours and unoccupied hours, the outside air damper shall be closed unless unoccupied cooling can be achieved via economizer.
3. Cooling - on a call for cooling, the chilled water coil shall maintain a minimum 55°F (adj.) Leaving air temperature with the outside air damper in the minimum position to satisfy the space cooling requirements. The supply air temperature can be reset to 65°F max if all cooling loads are satisfied.
4. Heating - on a call for heating, the control valves on the steam coils shall modulate to maintain 58°F (adj.) Leaving air temperature with the outside air damper in the minimum position to satisfy the space heating requirements. If all spaces are

- satisfied for cooling, the heating supply air temperature shall be reset to 65°F max.
5. "morning warm-up" mode
    - a. The supply fan shall operate continuously and the outside air damper shall be closed.
    - b. The BAS shall command all of the new VAV boxes to fully open their inlet damper and the control valves on the hot water pre-heat coil shall modulate to raise the building space temperature to 70°F (adj.).
    - c. The outdoor air temperature sensor shall anticipate the warm-up start time to achieve occupied temperatures at opening.
  6. Fire alarm shutdown – If the duct smoke detectors sense smoke, then any combination fire/smoke dampers shall close and the associated unit shall be de-energized. The unit shall not be permitted to operate until all trouble signals are cleared on the fire alarm system.
  7. The freezestat shall be wired with the fan starter. Whenever the air temperature upstream of the coils is 36°F, the fan shall stop, the outside air damper shall close and the chilled water and heating water valves shall open. A manual reset shall return the unit to normal operation.

#### 4.03 S PLIT SYSTEM HEAT PUMPS

- A. General
  1. Air Handling Unit (AHU) shall be provided with a wall mounted single-stage cool/two-stage heat programmable 24 hr./ 7-day thermostat with occupied/unoccupied scheduling and independent emergency heat operation.
  2. ATC contractor shall install and wire thermostat. Confirm final location with architect prior to rough-in.
  3. ATC contractor shall coordinate set points with owner.
  4. ATC contractor shall mount and wire condensate overflow switch.
  5. AHU shall be interlocked with remote duct mounted electric heating coil.
  6. Split system heat pump shall be provided with an open protocol BACNET controller.
  7. Occupied/Unoccupied shall be determined by the BAS time clock.
- B. Operation (occupied mode)
  1. Cooling - on a call for cooling, the unit shall operate to maintain 72°F (adj.).
  2. Heating - on a call for heating, the thermostat shall enable the unit's heat (heat pump) operate to maintain 70°F (adj)
  3. The condensate overflow switch mounted in the cooling coil drain pan shall deenergize the unit whenever enabled. Unit shall be manually restarted.
- C. Operation (unoccupied mode)
  1. Cooling - on a call for cooling, the unit shall operate to maintain 78°F (adj.).
  2. Heating - on a call for heating, the thermostat shall enable the unit's heat (heat pump) operate to maintain 65°F (adj.).
  3. The condensate overflow switch mounted in the cooling coil drain pan shall disable the unit whenever enabled. Unit must be manually restarted.
- D. Provide a duct smoke detector in each unit 2,000 CFM or over in the return air connection and in the supply air ductwork.
- E. Fire alarm shutdown – If the duct smoke detectors sense smoke, then any combination fire/smoke dampers shall close and the associated unit shall be de-energized. The unit shall not be permitted to operate until all trouble signals are cleared on the fire alarm system.
- F. Ventilation air - during occupied hours, the outside air damper shall be open. During the

evening hours and unoccupied hours, the outside air damper shall be closed unless unoccupied cooling can be achieved via economizer.

- G. Air-side economizer - when the outside air temperature is lower than the space air temperature and the outside air dewpoint temperature is below 55°F, the unit shall operate in 100% outside air mode with no mechanical cooling. ATC contractor to integrate remote relief air controls.
- H. Integrate with the BAS.

#### 4.04 VAV BOX WITH ELECTRIC HEAT (NO FAN)

- A. VAV boxes shall be provided with an open protocol BACNET controller with morning warm-up controls.
- B. VAV boxes shall be provided with wall mounted space sensors (as shown on the plans) with override.
- C. Operation
  1. Occupied cooling - on a call for cooling, the VAV box primary air valve shall modulate to satisfy the space setpoint temperature.
  2. Occupied heating - on a call for heating, the VAV box primary air valve shall modulate to the heating CFM position and the VAV box reheat coil shall be staged to satisfy the space setpoint temperature.
  3. Unoccupied cooling - on a call for cooling, the VAV box primary air valve shall modulate to satisfy the unoccupied space setpoint temperature.
  4. Unoccupied heating - on a call for heating, the VAV box primary air valve shall be locked at the minimum position and heating shall be provided by the VAV box heating coil.
  5. VAV box controls to be integrated with perimeter heating system controls (electric heaters, heating hot water radiation control valve (2-way). (Specifier: Need to indicate if the perimeter heating is the first stage or second stage of heating in relation to the VAV box heating being energized).
  6. Integrate VAV box controls with associated air handling unit and associated VFD controls.
- D. Integrate with the BAS.

#### 4.05 FAN POWERED VAV BOX WITH HOT WATER REHEAT

- A. General
  1. VAV boxes shall be provided with an open protocol BACNET controller with morning warm-up controls.
  2. VAV boxes shall be provided with wall mounted space sensors (as shown on the plans) with override.
- B. Operation
  1. Occupied cooling - on a call for cooling, the VAV box primary air valve shall modulate to satisfy the space setpoint temperature. Once the cooling requirements of the space are met, the VAV box primary air valve shall modulate to maintain the minimum cooling supply air CFM setpoint and the VAV box supply fan shall modulate to maintain constant volume in the space.
  2. Occupied heating - on a call for heating, the VAV box primary air valve shall modulate to the heating CFM position and the VAV box supply fan shall provide the heating CFM. The heating coil two-way (3-way) valves shall open to satisfy the space

- setpoint temperature.
3. Unoccupied cooling - on a call for cooling, the VAV box primary air valve shall modulate to satisfy the unoccupied space setpoint temperature.
  4. Unoccupied heating - on a call for heating, the VAV box primary air valve shall be closed and the heating shall be provided by the VAV box supply fan and heating water coil.
  5. VAV box controls to be integrated with perimeter heating system controls (electric heaters, heating hot water radiation control valve (2-way)). (Specifier: Need to indicate if the perimeter heating is the first stage or second stage of heating in relation to the VAV box heating being energized).
  6. Integrate VAV box controls with associated air handling unit and associated VFD controls.
- C. All VAV boxes shall be grouped in time-of-day zones indexed globally by the new BAS controller and according to the time-of-day schedule for the air handling unit serving them. During the occupied mode (based on time-of-day schedule as specified by the owner (adjustable) and indexed through the central BAS controller), the VAV boxes in each zone shall be indexed to “occupied”.
- D. The supply air damper is controlled with minimum and maximum CFM settings. The VAV box controller will monitor the room temperature sensor and the air velocity sensor. The controller will modulate the damper, the recirculating air damper, and modulate the heating hot water control valve to maintain the desired room temperature. The controller energizes the fan based on the current occupancy mode.
- E. Occupied Mode: The fan runs continuously during cooling and intermittently during heating. Cooling Operation: The room temperature is compared to the cooling setpoint. The controller will modulate the supply air damper and the recirculated air damper in sequence to maintain the cooling setpoint and energize the supply fan. The supply air volume will be limited by the minimum and maximum supply air volume settings. The heat will be off. Heating Operation: The room temperature is compared to the heating setpoint. The controller will modulate the heating hot water control valve to maintain the heating setpoint. The supply air volume is set to minimum and the recirculated plenum air is set to maximum.
- F. Unoccupied Mode; Upon a command from the BAS panel to change over to unoccupied mode, the VAV box controller will control using the night heating and cooling setpoints. The fan will cycle on and off to maintain the minimum temperature setback. The primary air valve shall be tightly closed.
- G. Integrate with the BAS.

#### 4.06 DUCTLESS SPLIT SYSTEM

- A. General
1. The indoor unit shall be furnished with a wireless, wall mounted programmable 24 hr./7-day thermostat. ATC contractor shall install and wire thermostat.
  2. ATC contractor shall wire outdoor unit to the indoor unit.
  3. The unit shall include a low ambient kit. ATC contractor shall wire the outside air temperature sensor.
  4. The units shall be circuited to standby power.
  5. Ductless split system to be furnished with a BACNET network card.
  6. Integrate with the BAS.
- B. Operation

1. Cooling - on a call for cooling, the indoor unit shall operate to maintain 72°F (adj.) In the space.
  2. Heating - on a call for heating, the indoor unit shall operate to maintain 60°F (adj.) In the space.
- C. Integrate with the BAS

#### 4.07 EXHAUST FANS

- A. General:
1. The toilet room exhaust fans shall be controlled by the BAS.
  2. Rooftop exhaust fans shall have automatic motor operated dampers in the roof curb which shall close when the fan is de-energized. Mechanical Contractor/ATC Contractor to provide power to the dampers.
  3. Fan status (on/off) and start/stop points shall be shown on the BAS workstation.
  4. 0-10V speed controllers shall be furnished with each exhaust fan listed in the equipment schedule for balancing purposes.
- B. Operation:
1. EF-6,7 (public bathrooms) - the fan shall operate continuously during occupied hours. This fans will not be installed as part of the Phase 1.
  2. EF-2 (electrical room) - the fan(s) shall operate when the space temperature rises above 85°F (adj.). An alarm signal shall be sent to the BAS if the room temperature exceeds 95°F.
- C. Refer to exhaust fan schedule for specific controls descriptions.
- D. Integrate with the BAS. The following monitoring points shall be available:
1. Fan Status ON/OFF
  2. Alarm

#### 4.08 SMOKE DAMPERS (SD) AND COMBINATION FIRE/SMOKE DAMPERS (FSD)

- A. Smoke dampers (SD) and combination fire/smoke dampers (FSD) shall be furnished by the mechanical contractor and installed by the mechanical contractor (or sheet metal sub-contractor). The electrical contractor shall provide 120V power to all smoke dampers and combination fire/smoke dampers (refer to electrical drawings). The fire alarm sub-contractor shall wire the smoke damper or combination fire/ smoke damper to the digital addressable fire alarm system.
- B. Refer to cover sheet or equipment schedules for smoke damper and combination fire/smoke damper specification. Smoke dampers and combination fire/smoke dampers shall be power open, spring closed type (fail closed).
- C. Smoke dampers and combination fire/smoke dampers shall be furnished with open / closed blade indication module (OCI). The fire alarm sub-contractor shall wire the OCI module to the addressable fire alarm system.
- D. Addressable duct mounted smoke detectors or full area smoke detection shall be provided for each smoke damper and combination fire/smoke damper in accordance with international mechanical code section 607.3.3.
- E. The addressable duct mounted smoke detectors shall be furnished by the fire alarm sub-contractor, mounted by the mechanical contractor (or sheet metal sub-contractor) and wired to the addressable fire alarm system by the fire alarm sub-contractor.
- F. Do not integrate with the BAS.



#### 4.09 CARBON DIOXIDE RESET

- A. Applies to: All HVAC units with outside air.
- B. Furnish and install a carbon dioxide space sensor which shall reset the outside air damper position to respond to occupancy carbon dioxide levels. Integrate with associated HVAC unit controls.
- C. Sensor shall be installed in a protective cover (clear plastic with locking cover). Coordinate final location with engineer.
- D. On a rise in carbon dioxide levels above the set point (700 PPM) of more than 2 zones under the same AHU, the BAS shall gradually open (up to a maximum pre-set position) the associated AHU's outside air damper.
- E. On a fall in carbon dioxide levels below the set point (for all the zones under the same AHU), the BAS shall gradually close the associated AHU's outside air damper down to its pre-set minimum position.
- F. Integrate with the BAS.

#### 4.10 SUSPENDED UNIT HEATERS - HOT WATER

- A. General - Refer to equipment schedule additional information.
- B. Provide a wall mounted thermostat which shall start and stop the unit heater to maintain space temperatures. Fan shall start and stop and control valve (2-way, 3-way) shall modulate open/closed to maintain space temperature.
- C. Unit heaters in public areas such as stair towers, lobbies and vestibules shall be furnished with integral tamperproof unit mounted thermostats.
- D. Unit heaters in mechanical rooms, electrical rooms and other back-of-house areas shall be furnished with wall mounted thermostats unless noted otherwise.
- E. Do not integrate with the BAS.

#### 4.11 CONVECTORS, CABINET UNIT HEATERS, EXTENDED FIN RADIATION - HOT WATER

- A. General - Refer to equipment schedule for additional information.
- B. Furnish and install a wall mounted thermostat which shall gradually modulate a two-way or three-way control valve to pass more or less hot water through the heating element to maintain space temperatures.
- C. Baseboard/extended fan radiation heaters, wall convectors and cabinet unit heaters in stair towers, lobbies and vestibules shall be furnished with integral tamperproof unit mounted thermostats.
- D. Do not integrate with the BAS.

#### 4.12 DUCT MOUNTED SMOKE DETECTORS

- A. In air systems with a capacity greater than 2,000 CFM, furnish and install duct mounted smoke detectors in the supply air (downstream the air filters and upstream of any branch duct) and return air ductwork.
- B. In multi-story buildings at each story with a commonly shared return and having a capacity

- greater than 15,000 CFM's furnish and install smoke detectors before the connection to the common return and before any connection to any recirculation or fresh air inlet in the return air systems. This includes plenums where the plenum is used for a common return.
- C. The fire alarm sub-contractor shall furnish a fire alarm monitoring module for each required air handling system. The ATC Contractor shall wire the fire alarm monitoring module to the emergency shutdown contacts or combination motor starter/disconnect on each air handling system.
  - D. Detectors shall de-energize the unit and signal the addressable fire alarm system if smoke is detected.
  - E. Detectors shall be accessible. Mechanical contractor shall be responsible for providing all necessary access panels and doors.
  - F. Duct smoke detectors to be furnished by the Electrical/ Mechanical Contractor.
  - G. Integrate with the BAS.

#### 4.13 SPACE HIGH TEMPERATURE AND HIGH HUMIDITY SENSORS/ALARMS

- A. Furnish and install wall mounted high temperature and high humidity sensors in the spaces where indicated on the drawings. An alarm shall be sent to the BAS when limits exceed setpoint settings.
- B. Integrate the sensors and alarms with the Campus BAS.
- C. Application: Furnish and install space temperature and humidity sensors/alarms in the following spaces:
  - 1. Electric Rooms
  - 2. IDF/MDF rooms
  - 3. Server/Computer room
- D. Integrate with the BAS.

END OF SECTION

## SECTION 23 21 13 - HYDRONIC PIPING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
1. Steel pipe and fittings.
  2. Plastic pipe and fittings.
  3. Joining materials.
  4. Transition fittings.
  5. Dielectric fittings.
  6. Bypass chemical feeder.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
1. Pipe.
  2. Fittings.
  3. Joining materials.
  4. Bypass chemical feeder.
- B. Sustainable Design Submittals:
1. Product Data: For adhesives, indicating VOC content.
  2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
  3. Environmental Product Declaration: For each product.
- C. Delegated-Design Submittal:
1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
  2. Locations of pipe anchors and alignment guides and expansion joints and loops.
  3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
  4. Locations of and details for penetration and firestopping for fire and smoke rated wall and floor and ceiling assemblies.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.04 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

## PART 2 - PRODUCTS

### 2.01 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
1. Hot-Water Heating Piping: 100 psig at 200 deg. F.
  2. Chilled-Water Piping: 150 psig 73 deg. F.
  3. Makeup-Water Piping: 150 psig at 73 deg. F.
  4. Blowdown-Drain Piping: 180 deg. F.
  5. Air-Vent Piping: 200 deg. F.
  6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

### 2.02 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.  
B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.  
C. DWV Copper Tubing: ASTM B 306, Type DWV.  
D. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.  
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:  
a. Anvil International.  
b. Victaulic Company.  
2. Grooved-End Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze casting.  
3. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg. F for use with housing, and steel bolts and nuts.  
E. Wrought-Copper Unions: ASME B16.22.

### 2.03 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.  
B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.  
C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.  
D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.  
E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.  
F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts,

nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
  2. End Connections: Butt welding.
  3. Facings: Raised face.
- G. Grooved Mechanical-Joint Fittings and Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International.
    - b. Victaulic Company.
  2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
  3. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

## 2.04 PLASTIC PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, with wall thickness as indicated in "Piping Applications" Article.
1. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.
- B. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.
1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

## 2.05 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BA9-1, silver alloy for joining copper with bronze or steel.
- F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for CPVC Piping: ASTM F 493.
1. Solvent cement shall have a VOC content of 490 g/L or less.

2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- H. Solvent Cements for PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
1. Solvent cement shall have a VOC content of 510 g/L or less.
  2. Adhesive primer shall have a VOC content of 550 g/L or less.
  3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  4. Adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.06 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. IPEX USA LLC.
    - c. KBI (King Bros. Industries).
    - d. Viega LLC.
  2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.
- B. Plastic-to-Metal Transition Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. IPEX USA LLC.
    - c. KBI (King Bros. Industries).
    - d. NIBCO INC.
  2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

## 2.07 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Capitol Manufacturing Company.
    - c. Central Plastics Company.

- d. HART Industrial Unions, LLC.
  - e. Jomar Valve.
  - f. Matco-Norca.
  - g. Watts; a Watts Water Technologies company.
  - h. Wilkins.
  - i. Zurn Industries, LLC.
2. Description:
- a. Standard: ASSE 1079.
  - a. Pressure Rating: 125 psig minimum at 180 deg. F.
  - b. End Connections: Solder-joint copper alloy and threaded ferrous.

## 2.08 BYPASS CHEMICAL FEEDER

- A. Description: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.
- 1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

## PART 3 - EXECUTION

### 3.01 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2-inch and smaller, shall be one of the following:
- 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
  - 2. Schedule 40 steel pipe, Grade B, ASTM 53, Seamless; Class 125, cast-iron fittings; screwed fittings.
- B. Hot-water heating piping, aboveground, NPS 2 ½ -inch and larger, shall be one of the following:
- 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] joints.
  - 2. Schedule 40 steel pipe, Grade B, ASTM 53, Seamless; Class 125, cast-iron fittings; cast-iron flanges and flange fittings.
- C. Hot-Water Heating Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- D. Chilled-water piping, aboveground, NPS 2-inch and smaller, shall be one of the following:
- 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
  - 2. Schedule 40 steel pipe, Grade B, ASTM 53, Seamless; Class 125, cast-iron fittings; screwed fittings.
- E. Chilled-water piping, aboveground, NPS 2 ½ -inch and larger, shall be one of the following:
- 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] joints.
  - 2. Schedule 40 steel pipe, Grade B, ASTM 53, Seamless; Class 125, cast-iron fittings; cast-iron flanges and flange fittings.
- F. Chilled-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- G. Makeup-water piping installed aboveground shall be the following:

- 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- H. Makeup-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- I. AC Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- J. AC Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
- K. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- L. Air-Vent Piping:
  - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
  - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- M. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

### 3.02 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4-inch ball valve, and short NPS 3/4-inch threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to the following:
  - 1. Section 230523.11 "Globe Valves for HVAC Piping."



2. Section 230523.12 "Ball Valves for HVAC Piping."
  3. Section 230523.13 "Butterfly Valves for HVAC Piping."
  4. Section 230523.14 "Check Valves for HVAC Piping."
  5. Section 230523.15 "Gate Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2-inch and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2 ½ -inch and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."
- Y. Piping shall not be installed over electrical panels, equipment, transformers, motor control centers, switch, gear, or substations. If absolutely necessary piping may be sleeved to prevent water from falling on electrical gear provided the installation is acceptable to the electrical inspectors and shall be approved by the engineer prior to installation.
- Z. Allow clearances for expansion and contraction. Provide swing ells at connection points so as not to strain piping systems.
- AA. Exposed insulated risers shall be covered with 22 gauge galvanized steel sleeves from floor to ceiling.
- BB. All piping shall be installed on the interior conditioned side of the building insulation.
- CC. Piping shall not be insulated until it is pressure and leak tested and until the building is closed in.

### 3.03 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2-inch and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2 ½ -inch to NPS 4-inch: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5-inch and Larger: Use dielectric flange kits.

### 3.04 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
  3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  4. Spring hangers to support vertical runs.
  5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
  6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4-inch: Maximum span, 7 feet.
  2. NPS 1-inch: Maximum span, 7 feet.
  3. NPS 1 ½ -inch: Maximum span, 9 feet.
  4. NPS 2-inch: Maximum span, 10 feet.
  5. NPS 2 ½ -inch: Maximum span, 11 feet.
  6. NPS 3-inch and Larger: Maximum span, 12 feet.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 -inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  2. NPS 1-inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  3. NPS 1 ¼ -inch: Maximum span, 6 feet; minimum rod size, 3/8 inch.
  4. NPS 1 ½ -inch: Maximum span, 6 feet; minimum rod size, 3/8 inch.
  5. NPS 2 -inch: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  6. NPS 2 ½ -inch: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  7. NPS 3-inch and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points. PVC piping to be supported on 4'-0" spacing unless approved otherwise.
- G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

### 3.05 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or

damaged. Do not use pipe sections that have cracked or open welds.

- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
  4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

### 3.06 WELDING

- A. All concealed black steel piping shall be fusion welded.
- B. Welding shall be performed in conformance with the ASME Boiler and Pressure Vessel Code Section IX.
- C. Elbows, tees, and branch connections shall be made with welding fittings ANSI B16.9.
- D. Furnish welder test certificates for review. Certificates of successful welder qualification by the following organizations shall be acceptable;
  - ASME Boiler and Pressure Vessel Code
  - ANSI Code for Pressure Piping
  - National Certified Pipe Welding Bureau
  - Military Specification MIL-STD-248.
- E. Weld-o-lets and Thread-o-lets are allowed but shall be a maximum of one size smaller than line size, i.e., a maximum of a 3 inch weld-o-let on a 4 inch pipe.

### 3.07 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

### 3.08 CHEMICAL TREATMENT

- A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

- B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.
- C. Fill systems that have antifreeze or glycol solutions with the following concentrations:
  - 1. Hot-Water Heating Piping: Minimum of 30 percent propylene glycol at a freezing point of 2.4F.
  - 2. Chilled-Water Piping: Minimum of 30 percent propylene glycol at a freezing point of 2.4F.

### 3.09 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
  - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
  - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  - 3. Isolate expansion tanks and determine that hydronic system is full of water.
  - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
  - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  - 6. Prepare written report of testing.
- C. Perform the following before operating the system:
  - 1. Open manual valves fully.
  - 2. Inspect pumps for proper rotation.
  - 3. Set makeup pressure-reducing valves for required system pressure.
  - 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
  - 5. Set temperature controls so all coils are calling for full flow.
  - 6. Inspect and set operating temperatures of hydronic equipment, such as boilers,

7. chillers, cooling towers, to specified values.  
Verify lubrication of motors and bearings.

END OF SECTION

## SECTION 23 21 16 - HYDRONIC PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes special-duty valves and specialties for the following:
  - 1. Hydronic specialty valves.
  - 2. Air-control devices.
  - 3. Strainers.
  - 4. Connectors.
- B. Related Requirements:
  - 1. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for expansion fittings and loops.
  - 2. Section 230523.11 "Globe Valves for HVAC Piping" for specification and installation requirements for globe valves common to most piping systems.
  - 3. Section 230523.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
  - 4. Section 230523.13 "Butterfly Valves for HVAC Piping" for specification and installation requirements for butterfly valves common to most piping systems.
  - 5. Section 230523.14 "Check Valves for HVAC Piping" for specification and installation requirements for check valves common to most piping systems.
  - 6. Section 230523.15 "Gate Valves for HVAC Piping" for specification and installation requirements for gate valves common to most piping systems.
  - 7. Section 230923.11 "Control Valves" for automatic control valve and sensor specifications, installation requirements, and locations.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Hydronic Specialty Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow control valves.
  - 2. Air-control devices.
  - 3. Strainers
  - 4. Connectors.

#### 1.03 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.04 QUALITY ASSURANCE

- A. ASME Compliance: Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME

Boiler and Pressure Vessel Code: Section VIII, Division.

## **PART 2 - PRODUCTS**

### 2.01 HYDRONIC SPECIALTY VALVES

#### A. Plastic Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Asahi/America.
  - c. Charlotte Pipe and Foundry Company.
  - d. Colonial Engineering, Inc.
  - e. Georg Fischer Inc.
  - f. Hayward Flow Control.
  - g. IPEX USA LLC.
  - h. Jomar Valve.
  - i. KBI (King Bros. Industries).
  - j. Legend Valve & Fitting, Inc.
  - k. NIBCO INC.
  - l. Plast-O-Matic Valves, Inc.
  - m. SMC The Specialty Mfg. Co.
  - n. Thermoplastic Valves, Inc.
  - o. Watts; a Watts Water Technologies company.
2. Body: Two-, or three-piece CPVC or PVC to match piping.
3. Ball: Full-port CPVC or PVC to match piping.
4. Seats: PTFE.
5. Seals: EPDM.
6. End Connections: Socket, union, or flanged.
7. Handle Style: Tee shape.
8. CWP Rating: Equal to piping service.
9. Maximum Operating Temperature: Equal to piping service.
10. Comply with MSS SP-122.

#### B. Plastic Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Asahi/America.
  - c. Colonial Engineering, Inc.
  - d. Georg Fischer Inc.
  - e. Hayward Flow Control.
  - f. IPEX USA LLC.
  - g. Legend Valve & Fitting, Inc.
  - h. NIBCO INC.
  - i. Plast-O-Matic Valves, Inc.
  - j. SMC The Specialty Mfg. Co.
  - k. Thermoplastic Valves, Inc.
  - l. Watts; a Watts Water Technologies company.

2. Body: PVC or CPVC to match piping wafer type for installation between flanges.
  3. Disc: EPDM-coated steel.
  4. Seats: PTFE.
  5. Handle Style: Locking lever.
  6. CWP Rating: Equal to piping service.
  7. Maximum Operating Temperature: Equal to piping service.
- C. Plastic Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Valve, Inc.
    - b. Asahi/America.
    - c. Colonial Engineering, Inc.
    - d. Georg Fischer Inc.
    - e. Hayward Flow Control.
    - f. IPEX USA LLC.
    - g. KBI (King Bros. Industries).
    - h. Legend Valve & Fitting, Inc.
    - i. NIBCO INC.
    - j. Plast-O-Matic Valves, Inc.
    - k. SMC The Specialty Mfg. Co.
    - l. Thermoplastic Valves, Inc.
    - m. Watts; a Watts Water Technologies company.
  2. Body: Two-, or three-piece PVC or CPVC to match piping.
  3. Ends: Socket or flanged.
  4. Seats: PTFE.
  5. Check Style: Swing or ball type.
  6. CWP Rating: Equal to piping service.
  7. Maximum Operating Temperature: Equal to piping service.
- D. Bronze, Calibrated-Orifice, Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armstrong Pumps, Inc.
    - b. Bell & Gossett; a Xylem brand.
    - c. Flow Design, Inc.
    - d. Grinnell Mechanical Products.
    - e. Griswold Controls.
    - f. Nexus Valve, Inc.
    - g. NuTech Hydronic Specialty Products.
    - h. Taco.
    - i. Tour & Andersson; available through Victaulic Company.
    - j. Victaulic Company.
  2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
  3. Ball: Brass or stainless steel.
  4. Plug: Resin.
  5. Seat: PTFE.
  6. End Connections: Threaded or socket.
  7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
  8. Handle Style: Lever, with memory stop to retain set position.



9. CWP Rating: Minimum 125 psig.
  10. Maximum Operating Temperature: 250 deg. F.
- E. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AMTROL, Inc.
    - b. Apollo Valves; Conbraco Industries, Inc.
    - c. Armstrong Pumps, Inc.
    - d. Bell & Gossett; a Xylem brand.
    - e. Spence Engineering Company, Inc.
    - f. Watts; a Watts Water Technologies company.
  2. Body: Bronze or brass.
  3. Disc: Glass and carbon-filled PTFE.
  4. Seat: Brass.
  5. Stem Seals: EPDM O-rings.
  6. Diaphragm: EPT.
  7. Low inlet-pressure check valve.
  8. Inlet Strainer: Stainless steel removable without system shutdown.
  9. Valve Seat and Stem: Noncorrosive.
  10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
- F. Diaphragm-Operated Safety Valves: ASME labeled.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AMTROL, Inc.
    - b. Apollo Valves; Conbraco Industries, Inc.
    - c. Armstrong Pumps, Inc.
    - d. Bell & Gossett; a Xylem brand.
    - e. Spence Engineering Company, Inc.
    - f. Watts; a Watts Water Technologies company.
  2. Body: Bronze or brass.
  3. Disc: Glass and carbon-filled PTFE.
  4. Seat: Brass.
  5. Stem Seals: EPDM O-rings.
  6. Diaphragm: EPT.
  7. Wetted, Internal Work Parts: Brass and rubber.
  8. Inlet Strainer: Stainless steel, removable without system shutdown.
  9. Valve Seat and Stem: Noncorrosive.
  10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
- G. Automatic Flow-Control Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Caleffi.
    - b. Flow Design, Inc.
    - c. Griswold Controls.
    - d. Hays Fluid Controls.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel tamper proof, self-cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig 300 psig.
9. Maximum Operating Temperature: 200 deg. F 250 deg. F.

## 2.02 AIR-CONTROL DEVICES

### A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett; a Xylem brand.
  - d. Taco, Inc.
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2-inch.
6. Discharge Connection: NPS 1/8-inch.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 225 deg. F.
9. Commercial buildings shall have high-capacity vents.

### B. Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett; a Xylem brand.
  - d. Flo Fab Inc.
  - e. Taco, Inc.
2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg. F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested after taps are fabricated and shall be labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg. F maximum operating temperature.
4. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg. F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.

5. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- diameter gage glass, and slotted-metal glass guard.
- C. In-Line Air Separators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AMTROL, Inc.
    - b. Armstrong Products, Inc.
    - c. Bell & Gossett; a Xylem brand.
    - d. Spirotherm, Inc.
    - e. Taco, Inc.
  2. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
  3. Maximum Working Pressure: Up to 175 psig.
  4. Maximum Operating Temperature: Up to 300 deg. F.
- D. Combination Air Eliminator and Dirt Separators
1. Manufacturers
    - a. Spirotherm, Inc. (model VDT, VHT, VDN or VHN)
    - b. Bell & Gossett; a Xylem brand.
    - c. Taco, Inc.
  2. Full flow coalescing type combination air eliminator and dirt separator shall be fabricated steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels, and include two equal chambers above and below the inlet / outlet nozzles.
  3. Selection shall be based upon system flow with pipe size as a minimum. In no case shall entering velocity exceed 10 feet per second.
  4. Unit shall include internal structured elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. The elements must be fabricated by the manufacturer and consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed.
  5. Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.
  6. Units shall include a side tap valve to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.
  7. Optional: Unit shall be manufactured with a removable lower head for internal inspection if so noted on the drawings and schedule.

## 2.03 STRAINERS

- A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
  2. End Connections: Threaded ends for NPS 2-inch and smaller; flanged ends for NPS 2 ½ -inch and larger.
  3. Strainer Screen: Stainless-steel, 40 mesh strainer, or perforated stainless-steel

- basket.
- 4. CWP Rating: 125 psig.

## 2.04 CONNECTORS

- A. Stainless-Steel Bellow, Flexible Connectors:
  - 1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
  - 2. End Connections: Threaded or flanged to match equipment connected.
  - 3. Performance: Capable of 3/4-inch misalignment.
  - 4. CWP Rating: 150 psig.
  - 5. Maximum Operating Temperature: 250 deg. F.

## PART 3 - EXECUTION

### 3.01 VALVE APPLICATIONS

- A. Install shut off-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

### 3.02 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2-inch and larger.
- D. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
  - 1. Install tank fittings that are shipped loose.
  - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

- E. Install expansion tanks on the floor. Vent and purge air from hydronic system and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION

## **SECTION 23 23 00 - REFRIGERANT PIPING**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Refrigerant pipes and fittings.
  - 2. Refrigerant piping valves and specialties.
  - 3. Refrigerants.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of valve, refrigerant piping, and refrigerant piping specialty.
- B. Sustainable Design Submittals:
  - 1. Product Data for EA Prerequisite 3, "Fundamental Refrigerant Management": For refrigerants, indicating compliance with refrigerant management practices.
- C. Shop Drawings:
  - 1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
  - 2. Show interface and spatial relationships between piping and equipment.
  - 3. Shop Drawing Scale: 1/4-inch equals 1 foot.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

#### 1.05 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

### **PART 2 - PRODUCTS**

## 2.01 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
1. Suction Lines for Air-Conditioning Applications: 300 psig.
  2. Suction Lines for Heat-Pump Applications: 535 psig.
  3. Hot-Gas and Liquid Lines: 535 psig.

## 2.02 COPPER TUBE AND FITTINGS

- A. Copper Tube: [ASTM B 88, Type K or L (ASTM B 88M, Type A or B)] [ASTM B 280, Type ACR].
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8/A5.8M.
- F. Flexible Connectors:
1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  2. End Connections: Socket ends.
  3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
  4. Working Pressure Rating: Factory test at minimum 500 psig.
  5. Maximum Operating Temperature: 250 deg. F.

## 2.03 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Heldon Products; Henry Technologies.
    - c. Parker - Sporlan Hannifin Corp.
    - d. Paul Mueller Company.
  2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
  3. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
  4. Operator: Rising stem and hand wheel.
  5. Seat: Nylon.
  6. End Connections: Socket, union, or flanged.
  7. Working Pressure Rating: 500 psig.
  8. Maximum Operating Temperature: 275 deg. F.
- B. Packed-Angle Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Heldon Products; Henry Technologies.
    - c. Parker - Sporlan Hannifin Corp.

- d. Paul Mueller Company.
  2. Body and Bonnet: Forged brass or cast bronze.
  3. Packing: Molded stem, back seating, and replaceable under pressure.
  4. Operator: Rising stem.
  5. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
  6. Seal Cap: Forged brass or valox hex cap.
  7. End Connections: Socket, union, threaded, or flanged.
  8. Working Pressure Rating: 500 psig.
  9. Maximum Operating Temperature: 275 deg. F.
- C. Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Heldon Products; Henry Technologies.
    - d. Parker Hannifin Corp.
    - e. Paul Mueller Company.
  2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
  3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
  4. Piston: Removable polytetrafluoroethylene seat.
  5. Closing Spring: Stainless steel.
  6. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
  7. End Connections: Socket, union, threaded, or flanged.
  8. Maximum Opening Pressure: 0.50 psig.
  9. Working Pressure Rating: 500 psig.
  10. Maximum Operating Temperature: 275 deg. F.
- D. Service Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Heldon Products; Henry Technologies.
    - d. Parker Hannifin Corp.
    - e. Paul Mueller Company.
    - f. Refrigeration Sales, Inc.
  2. Body: Forged brass with brass cap including key end to remove core.
  3. Core: Removable ball-type check valve with stainless-steel spring.
  4. Seat: Polytetrafluoroethylene.
  5. End Connections: Copper spring.
  6. Working Pressure Rating: 500 psig.
- E. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Heldon Products; Henry Technologies.



- d. Parker Hannifin Corp.
- e. Paul Mueller Company.
- 2. Body and Bonnet: Plated steel.
- 3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
- 4. Seat: Polytetrafluoroethylene.
- 5. End Connections: Threaded.
- 6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and [24] [115] [208]-V ac coil.
- 7. Working Pressure Rating: 400 psig.
- 8. Maximum Operating Temperature: 240 deg. F.
- F. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Heldon Products; Henry Technologies.
    - c. Parker - Sporlan Hannifin Corp.
    - d. Paul Mueller Company.
  - 2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
  - 3. Piston, Closing Spring, and Seat Insert: Stainless steel.
  - 4. Seat: Polytetrafluoroethylene.
  - 5. End Connections: Threaded.
  - 6. Working Pressure Rating: 400 psig.
  - 7. Maximum Operating Temperature: 240 deg. F.
- G. Thermostatic Expansion Valves: Comply with AHRI 750.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Parker - Sporlan Hannifin Corp.
  - 2. Body, Bonnet, and Seal Cap: Forged brass or steel.
  - 3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  - 4. Packing and Gaskets: Non-asbestos.
  - 5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
  - 6. Suction Temperature: 40 deg. F
  - 7. Superheat: Adjustable
  - 8. Reverse-flow option (for heat-pump applications).
  - 9. End Connections: ODF female, sweat connection, flare.
  - 10. Working Pressure Rating: 700 psig for 410A, 450 psig for non-410A
  - 11. Equalizer: External
- H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Heldon Products; Henry Technologies.
    - c. Parker -sporlan Hannifin Corp.
  - 2. Body, Bonnet, and Seal Cap: Ductile iron or steel.

3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  4. Packing and Gaskets: Non-asbestos.
  5. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  6. Seat: Polytetrafluoroethylene.
  7. Equalizer: External
  8. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and 120-V ac coil.
  9. End Connections: Socket. ODF female, sweat connection, flare.
  10. Set Pressure: 150 psi for 410A
  11. Throttling Range: Maximum 5 psig.
  12. Working Pressure Rating (max): 700 psig.
  13. Maximum Operating (fluid) Temperature: 240 deg. F.
  14. Max ambient Temperature: 120 deg. F
- I. Straight-Type Strainers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Heldon Products; Henry Technologies.
    - c. Parker Hannifin Corp.
  2. Body: Welded steel with corrosion-resistant coating.
  3. Screen: 100-mesh stainless steel.
  4. End Connections: Socket or flare.
  5. Working Pressure Rating: 500 psig.
  6. Maximum Operating Temperature: 275 deg. F.
- J. Angle-Type Strainers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Heldon Products; Henry Technologies.
    - c. Parker Hannifin Corp.
  2. Body: Forged brass or cast bronze.
  3. Drain Plug: Brass hex plug.
  4. Screen: 100-mesh monel.
  5. End Connections: Socket or flare.
  6. Working Pressure Rating: 500 psig.
  7. Maximum Operating Temperature: 275 deg. F.
- K. Moisture/Liquid Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Heldon Products; Henry Technologies.
    - d. Parker – Sporlan Hannifin Corp.
  2. Body: Forged brass.
  3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
  4. Indicator: Color coded to show moisture content in parts per million (ppm).

5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
  6. End Connections: Socket or flare.
  7. Working Pressure Rating: 650 psig
  8. Maximum Operating Temperature: 240 deg. F.
- L. Replaceable-Core Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Heldon Products; Henry Technologies.
    - d. Parker Hannifin Corp.
  2. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
  3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
  4. Desiccant Media: Molecular sieve, Activated alumina.
  5. End Connections: Socket.
  6. Access Ports: NPS 1/4-inch connections at entering and leaving sides for pressure differential measurement.
  7. Maximum Pressure Loss: 2 psig
  8. Working Pressure Rating: 650psig
  9. Maximum Operating Temperature: 240 deg. F.
- M. Permanent Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss Inc.
    - b. Emerson Climate Technologies.
    - c. Heldon Products; Henry Technologies.
    - d. Parker – Sporlan Hannifin Corp.
  2. Body and Cover: Painted-steel shell.
  3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
  4. Desiccant Media: Molecular sieve, Activated alumina.
  5. End Connections: Socket
  6. Maximum Pressure Loss: 2 psig
  7. Working Pressure Rating: 650 psig
  8. Maximum Operating Temperature: 240 deg. F.

## 2.04 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Arkema Inc.
    - b. DuPont Fluorochemicals Div.
    - c. Genetron Refrigerants; Honeywell International Inc.
    - d. Mexichem Fluor Inc.

### **PART 3 - EXECUTION**

#### **3.01 PIPING APPLICATIONS FOR REFRIGERANT R-410A**

- A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR or Type L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
- D. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, Type K (A) or Type L (B), drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
- E. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, Type K (A), or Type L (B), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.
- F. Safety-Relief-Valve Discharge Piping: Copper, Type ACR or Type L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
- G. Safety-Relief-Valve Discharge Piping: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
- H. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, Type K (A), Type L (B), drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
- I. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, Type K (A) or Type L (B), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

#### **3.02 VALVE AND SPECIALTY APPLICATIONS**

- A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless or packed-angle valves on inlet and outlet side of filter dryers.
- E. Install a full-size, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
  - 1. Install valve so diaphragm case is warmer than bulb.
  - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
  - 3. If external equalizer lines are required, make connection downstream of the bulb location where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the

inlet of the evaporator coil capillary tube.

- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
  - 1. Solenoid valves.
  - 2. Thermostatic expansion valves.
  - 3. Hot-gas bypass valves.
  - 4. Compressor.
- K. Install filter dryers in liquid line between condenser and thermostatic expansion valve [, and in the suction line at the compressor].
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors (Vibration absorbers) at compressors.

### 3.03 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near

expansion-valve bulb.

- Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

### 3.04 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
  - 1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
  - 2. Use Type BA<sub>g</sub> (cadmium-free silver) alloy for joining copper with bronze or steel.

### 3.05 HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
  - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
  - 1. NPS 1/2-inch: Maximum span, 60 inches; minimum rod, 1/4 inch.
  - 2. NPS 5/8-inch: Maximum span, 60 inches; minimum rod, 1/4 inch.
  - 3. NPS 1-inch: Maximum span, 72 inches; minimum rod, 1/4 inch.
  - 4. NPS 1 ¼ -inch: Maximum span, 96 inches; minimum rod, 3/8 inch.
  - 5. NPS 1 ½ -inch: Maximum span, 96 inches; minimum rod, 3/8 inch.
- D. Support multifloor vertical runs at least at each floor.

### 3.06 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Comply with ASME B31.5, Chapter VI.
  - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser,

evaporator, and safety devices from test pressure if they are not rated above the test pressure.

3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
  - a. Fill system with nitrogen to the required test pressure.
  - b. System shall maintain test pressure at the manifold gage throughout duration of test.
  - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
  - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- B. Prepare test and inspection reports.

### 3.07 SYSTEM CHARGING

- A. Charge system using the following procedures:
  1. Install core in filter dryers after leak test but before evacuation.
  2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  4. Charge system with a new filter-dryer core in charging line.

### 3.08 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  1. Open shutoff valves in condenser water circuit.
  2. Verify that compressor oil level is correct.
  3. Open compressor suction and discharge valves.
  4. Open refrigerant valves except bypass valves that are used for other purposes.
  5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

## SECTION 23 31 13 - METAL DUCTS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Rectangular ducts and fittings.
  - 2. Round ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Sound attenuating duct lining.
  - 5. Sealants and gaskets.
  - 6. Hangers and supports.
- B. Related Sections:
  - 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.02 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ANSI/ASHRAE 62.1.

#### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Submittals:
  - 1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 - "Systems and Equipment."
  - 2. Product Data: For adhesives, indicating VOC content.
  - 3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
  - 4. Product Data: For sealants, indicating VOC content.
  - 5. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings:



1. Ductwork shop drawings must be properly submitted. Any ductwork installed without prior approval by the engineer and found to be incorrect, shall be replaced at the expense of the contractor.
  2. Submit shop drawings of all sheet metal for review. Drawings shall be not less than 1/4" scale and show all light fixtures, steel, piping, conduit, equipment and architectural features. It is unacceptable to resubmit and modify McHugh design documents for sheet metal drawing purposes.
    - a. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
    - b. Factory- and shop-fabricated ducts and fittings.
    - c. Duct layout indicating sizes, configuration, and static-pressure classes.
    - d. Elevation of top of ducts. Verify ductwork fits in available space.
    - e. Dimensions of main duct runs from building grid lines.
    - f. Fittings.
    - g. Reinforcement and spacing.
    - h. Seam and joint construction.
    - i. Penetrations through fire-rated and other partitions.
    - j. Equipment
    - k. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
    - l. Hangers and supports, including methods for duct and building attachment and vibration isolation.
    - m. Indicate waste and storm piping where it occurs in the area of ductwork.
    - n. Locate electrical gear on plan. Ductwork is not to run above panels.
    - o. Ductwork is to be shown double line with indicated width and height.
    - p. Allowance to be made for lining and/or insulation.
    - q. Duct sizes shown on contract drawings may be flattened to a 4 to 1 ratio when necessary to establish clearance. Such transitions are to be included in the contract price.
    - r. Ductwork fabrication shall not proceed until shop drawings are submitted for review.
    - s. All dampers, grilles, registers, diffusers, access panels, louvers, coils, filters, and other components of the system are to be indicated.
    - t. Provide detail of fire damper assembly.
    - u. Provide drawing sections when requested by the engineer.
    - v. Coordinate sheet metal drawings with light fixture layout and sprinkler system piping and heads and shown on the drawing.
- D. Delegated-Design Submittal:
1. Sheet metal thicknesses.
  2. Joint and seam construction and sealing.
  3. Reinforcement details and spacing.
  4. Materials, fabrication, assembly, and spacing of hangers and supports.

#### 1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  2. Suspended ceiling components.
  3. Structural members to which duct will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Penetrations of smoke barriers and fire-rated construction.
  6. Items penetrating finished ceiling including the following:
    - a. Luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Perimeter moldings.
- B. Welding certificates.

#### 1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
  3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

## PART 2 - PRODUCTS

### 2.01 RECTANGULAR DUCTS AND FITTINGS – SMACNA STANDARDS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.02 FABRICATED DUCT REQUIREMENTS - DUCTMATE

- A. All interior rectangular ducts shall be constructed with G-60 or better galvanized steel (ASTM A-653-94) LFQ, chem treat. Exterior ductwork shall be G-90 or better galvanized steel LFQ, chem treat. Kitchen, shower, or dishwasher exhaust shall be aluminum with aluminum joints.
- B. Materials: Support, access doors not part of ducts, bar or angle reinforcing damper rods and items made of uncoated mild steel shall be painted with two coats of primer or provide galvanized equivalent.
- C. Longitudinal Seams. Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.
- D. Flanged interior Gasket. Ductmate 440 or a Butyl Rubber Gasket which meets Mil-C 18969B, Type II Class B, TT-C-1796 A, Type II Class B, and TTS-S-001657 must also pass UL-723. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type of vehicle that will support fungal and/or bacterial growth associated with dark, damp areas of ductwork. The recommended test procedure for bacterial and fungal growth is found in 21CFR 177, 1210 closures with sealing gaskets for food containers.
- E. Ductmate or W.D.C.I. proprietary duct connection systems will be accepted. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.
- F. Formed - on flanges (T.D.C./T.D.F./T-25A/T-25B) be accepted. Formed on flanges will be constructed as SMACNA T-25 flanges, whose limits are defined on page 1.36 1995 SMACNA Manual, Second Edition. No other construction pertaining to formed - on flanges will be accepted. Formed on flanges shall be accepted for use on ductwork 42" wide or less and must include the use of corners, bolts, and cleat. (Over 42", the reinforcement/joint deflection criteria no longer conform with the UMC).
- G. Rectangular ductwork above the roof or outside shall be 4" water gauge construction.
- H. All ductwork in moist areas (Toilet Rooms, locker rooms, etc) shall be aluminum construction with aluminum hangers, supports, and fasteners.

## 2.03 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ductmate Industries, Inc.
    - b. Elgen Manufacturing.
    - c. Linx Industries (formerly Lindab).
    - d. McGill AirFlow LLC.
    - e. MKT Metal Manufacturing.

f. SEMCO LLC.

- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.04 SOUND ATTENUATING DUCT LINING

- A. Includes:
- All interior supply air ductwork.
  - All exterior supply air ductwork. Refer to exterior ductwork specifications (23 07 13) for additional requirements.
  - All interior return ductwork.
  - Return ductwork: Line the first 10'-0" of the main return ductwork extending from the air handling units.
  - All outside air ductwork.
  - All transfer air ductwork.
  - No kitchen supply and return ductwork shall be lined.
- Refer to ductwork insulation specification (23 07 13) for insulation requirements. Lining indicated is in addition to insulation requirements.
- B. Duct liner shall have a flame spread of not over 25, a fuel contributed of not over 50 and a smoke developed of not over 50.
- C. Liner shall be minimum 1 inch thick, 1.5 Lbs./Cu. Ft. density with a thermal conductance of .24 at 50 deg. F. mean temperature. (Conductance: BTU/Sq. Ft./F/Hr.).
- D. Liner shall not spall or deteriorate at air velocities to 4000 FPM when installed in accordance with the manufacturer's recommendations.
- E. Liner shall be Johns-Manville Linacoustic or approved substitute by Owens-Corning, CertainTeed, or Knauf. Observe all installation instructions.
- F. Any ductwork in unconditioned spaces or outdoors shall have insulation totaling R-8.3.

## 2.05 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction

Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation For Interior Ductwork: G60.
  - 2. Galvanized Coating Designation For Exterior Ductwork: G90.
  - 3. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.
- G. Fiberglass ductboard is not acceptable.

## 2.06 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 75 g/L (less water).
  - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
  - 1. General: Single-component, acid-curing, silicone, elastomeric.
  - 2. Type: S.
  - 3. Grade: NS.
  - 4. Class: 25.
  - 5. Use: O.
  - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 7. 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."

- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
  - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.07 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## PART 3 - EXECUTION

### 3.01 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

### 3.02 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.03 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1 ½-inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.
- D. Kitchen exhaust ductwork shall be installed in accordance with NFPA96.
- E. Ducts shall be fabricated of 16 gage steel with continuous welded seams. Provide 1 hour fire rating around duct vertically from above the ceiling and continuously up through the roof.
- F. Ducts shall lead to the exterior of the building as directly as possible.
- G. Duct shall not be interconnected with any other building ventilating or exhaust system.
- H. Cleanouts shall be provided at all dips or traps for continuous or automatic removal or residue.

- I. All exterior kitchen exhaust ductwork exposed to the elements shall be cleaned and painted with high temperature paint.

### 3.04 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Outdoor, Supply-Air Ducts: Seal Class A.
  - 3. Outdoor, Exhaust Ducts: Seal Class C.
  - 4. Outdoor, Return-Air Ducts: Seal Class C.
  - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
  - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
  - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
  - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
  - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
  - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
  - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
  - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with



welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.

- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.06 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.07 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.08 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
  - 1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior.
- B. Supply Ducts:
  - 1. All Supply Ductwork:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: C for 0-2"; B for 3"; A for 4",6",10".
    - c. SMACNA Leakage Class for Rectangular: 16 for 0-2"; 8 for 3"; 4 for 4",6",10".
    - d. SMACNA Leakage Class for Round and Flat Oval: 8 for 0-2"; 4 for 3"; 2 for 4",6",10".
  - 2. Ductwork from Unit Down Shaft to Floor:
    - a. Pressure Class: Positive 3-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 8.
    - d. SMACNA Leakage Class for Round and Flat Oval: 4.
  - 3. Ductwork from Shaft to VAV:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 16.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8.
- C. Return Ducts:
  - 1. All Return Ductwork:
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 16.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8.
- D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8.
  2. All Other Return Air Ductwork:
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: A
    - c. SMACNA Leakage Class for Rectangular: 16.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8.
  3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
    - a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
    - b. Concealed: Carbon-steel sheet – 16 gauge min.
    - c. Welded seams and joints.
    - d. Pressure Class: Positive or negative 2-inch wg.
    - e. Airtight/Watertight.
  4. Ducts Connected to Dishwasher Hoods:
    - a. Duct shall be Aluminum.
    - b. Welded seams and flanged joints with watertight EPDM gaskets.
    - c. Pressure Class: Positive or negative 2-inch wg.
    - d. Airtight/Watertight.
  5. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:
    - a. Type 316 Type 304, stainless-steel sheet.
      - 1) Exposed to View: No. 4 finish.
      - 2) Concealed: No. 2B or No. 2D finish.
    - b. PVC-coated, galvanized sheet steel with thicker coating on duct interior.
    - c. Pressure Class: Positive or negative 3-inch wg.
    - d. Minimum SMACNA Seal Class: Welded seams and joints.
    - e. SMACNA Leakage Class 3.
    - f. Airtight/Watertight.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 16.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8.
- F. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.
  2. PVC-Coated Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: Galvanized.
  3. Stainless-Steel Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: Galvanized.
  4. Aluminum Ducts: [Aluminum] [or galvanized sheet steel coated with zinc chromate].

G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Velocity 1000 fpm or Lower:
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
    - 2) Mitered Type RE 4 without vanes.
  - b. Velocity 1000 to 1500 fpm:
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - c. Velocity 1500 fpm or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

- a. Rectangular Main to Rectangular Branch: 45-degree entry.
    - b. Rectangular Main to Round Branch: Spin in.
  2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
    - a. Velocity 1000 fpm or Lower: 90-degree tap.
    - b. Velocity 1000 to 1500 fpm: Conical tap.
    - c. Velocity 1500 fpm or Higher: 45-degree lateral.
- I. General Requirements
  1. Ductwork in the pool and pool equipment room shall be aluminum construction with aluminum hangers, supports, and fasteners.
  2. Rectangular ductwork above the roof or outside shall be 4" water gauge construction.
- J. Rectangular ductwork in the pool and pool equipment room shall be aluminum construction with stainless steel (317L or 904L) hangers, supports, and fasteners.
  1. All ductwork in moist areas (Toilet Rooms, locker rooms, kitchens, etc.) shall be aluminum construction with aluminum hangers, supports, and fasteners.

END OF SECTION

## **SECTION 23 31 21 - DUCTWORK CLEANING**

### **PART 1 - GENERAL**

#### 1.01 REFERENCE

- A. Refer to Section 23 05 00 for requirements which are applicable to this section.
- B. Refer to NFPA and International Mechanical codes.
- C. Refer to ASHRAE, ASTM, OSHA and UL standards.
- D. Refer to NADCA (National Air Duct Cleaners Association) standards.
- E. Refer to ACR 2006 assessment, cleaning, and restoration of HVAC systems.

#### 1.02 WORK INCLUDED

- A. Provide all labor, material, equipment, and supervision necessary to inspect, clean and internally coat the existing supply air and return air duct system.

#### 1.03 SUBMITTALS

- A. Submit manufacturers' data sheets of coating.

#### 1.04 QUALITY ASSURANCE

- A. Provide adequate supervision of labor force to see that cleaning and coating operations are performed correctly.
- B. Work shall be performed by certified National Air Duct Cleaners Assoc. Specialists.
- C. Provide NADCA certificate at completion of work.

### **PART 2 - PRODUCTS**

#### 2.01 FUNGICIDAL PROTECTIVE COATING

- A. Polyacrylate copolymer emulsion specifically formulated for long term fungicidal activity, with no loss of activity on aging shall contain fungicides that will effectively prevent the growth and spread of molds and bacteria on its surface and provide a tough, elastic protective finish that allows for movement without splitting to create lodging places for bacteria.
- B. Properties:
  - 1. Color: White
  - 2. Application Consistency: Brush or Airless Spray
  - 3. Average non-volatile (ASTM C 461) - 58% by volume.
  - 4. Coverage Range (FSTM 71) - Wet coverages shown are for smooth non-porous

- surfaces. Porous or rough surfaces may require higher gallonage to obtain required dry thickness. 1.25 gal. /100 square feet 2 (0.51 l/m<sup>2</sup>); .020 in. Wet thickness (.51 mm); .011 in. Dry thickness (.27 mm).
5. Drying Time (ASTM D 1640) - Set to touch: 4 hours; dry through: 16 hours.
  6. Water Vapor Permeance (ASTM F 1249) - Tested at 90% R. H. differential and 100 deg. F (38 deg. C) 6.0. Perms at .011 in. (4.0 metric perms at .26 mm).
  7. Service Temperature Limits (FSTM 70) (Temperature at coated surface) - Minus 20 deg. F to 200 deg. F (-29 deg. C to 93 deg. C).
  8. Safety - Wet flammability (ASTM D 3278). No flash to boiling 210 deg. F (99 deg. C).
  9. Surface Burning Characteristics (ASTM E 84) - Flame Spread: 15 - Smoke Developed: 5. Tested at coverage rate of 80 square feet per gallon. Applied to inorganic reinforced cement board. The flame spread may vary at different product thicknesses and/or when applied over other surfaces.
- C. Manufacturer: Foster 40-20.

### **PART 3 - EXECUTION**

#### **3.01 DUCT CLEANING**

- A. Preparing and protecting work areas with 4ml. Poly, as necessary.
- B. Performing the work in compliance with the Occupational Safety and Health Administration (OSHA) Standards requiring compliance by all private employers on an ongoing basis under the General Industry (29CFR 1910) and Construction Industry (29CFR 1926). Regulations, which include but is not limited to:
  - o Record keeping OSHA 1910.20.
  - o Confined Space Entry Requirements OSHA 1910.146
  - o Respiratory Protection OSHA 1910.134
  - o Hazardous Communications OSHA 1910.1200
  - o Lock-Out/Tag-Out Protection OSHA 1910.147
- C. Marking the position of all balancing dampers prior to cleaning process.
- D. Removing and cleaning supply registers and exhaust air grills and louvers. (If removable)
- E. Providing access ports in accordance with SMACNA standards where necessary to thoroughly clean the entire system. Provide pre-manufactured latchable access panels.
- F. Removing, inspecting and installing upon completion all filtration devices. Install new filters matching existing filters.
- G. Removing of all visible debris and contaminants from the outside air duct system and other associated components. This is to be performed in accordance with NADC Standards 1992-01.
- H. Leaving all work areas in a neat and orderly fashion, and removing all accumulated debris from work site.
- I. All registers, grilles louvers to be securely reinstalled and mechanical dampers restored to their original positions.
- J. Checking total system upon completion to ensure functional operation in similar manner in which system was operating prior to cleaning process.

K. Any deficiencies reported to project engineer.

### 3.02 INTERNAL DUCT CLEANING AND COATING

- A. After cleaning and vacuuming inspect internal duct for damage and/or deterioration. Upon completion of the inspection, repair ductwork is required.
- B. After installation of the required access doors in the duct work and the removal of all loosened contaminants is completed, resurfacing, shall be accomplished as follows:
  - 1. Using a spraying system with approved resurfacing agent, Foster 40-20, apply a one (1) mil thickness wet application to the liner surfaces, or as recommended by the manufacturer's specifications. Ensure even coating with broad spray tip.
  - 2. Odors shall be controlled through the filters in the collection devices. Collection devices shall be connected to the targeted duct section so that a minimum negative pressure is maintained. Pressure within the area being resurfaced may be adjusted based on the size of the duct to restrict over spray or removal of the resurfacing. The intent of the negative pressure is to eliminate odors and to assist in the drying process, not to draw resurfacing agent into collection systems. A minimum negative pressure of .125" wg shall be used.
  - 3. Resurfacing agent shall be approved for use inside of air distribution systems. Additives for agents shall be approved by the Owner and shall be accompanied by a current MSDS.

### 3.03 FUNGICIDAL COATING

- A. Material Preparation: Do not thin. Keep container closed when not in use. Do not apply outdoors in damp or rainy weather.
- B. HVAC Systems: Galvanized surfaces need to be vacuumed or washed clean of all accumulated mold, dust and loose particles. Following complete cleaning procedures, sanitize the entire air duct surfaces with an approved sanitizer following manufacturer's directions. Insure that all interior surfaces are thoroughly dry before applying 40-20. All rusted metal surfaces must be primed with Foster 40-26 before application of 40-20. Lined air ducts should be lightly vacuum cleaned to remove all mold, dust and loose particles, being careful not to tear or loosen the liner. Following complete cleaning procedures, the entire air duct surfaces are to be sanitized as above.
- C. Application: Apply Foster 40-20 to all surfaces by brush, airless spray at a rate of approximately 1.25 gal. Per 100 square foot. Always ensure adequate ventilation. Brushing will require two coats applied at 90 degrees to each other. Under normal circumstances a spray application can be completed in one coat, but for extremely porous or irregular surfaces, a second coat may be required. Insure that the finished surface is smooth and homogeneous. For airless spray application, uses an electric 30:1 unit such as a Graco EH-433 with a .021-.025 fluid tip and 800-900 psi atomizing pressure at the gun.
- D. For HVAC systems interior surfaces: Always ensure negative air pressure in the HVAC system during application. After one hour has elapsed from completion of application, circulate fresh air throughout the system to dry the coating. Be sure exhausted air is odorless before ventilating into occupied room areas.
- E. Clean-up - Use fresh water to clean brushes and equipment before product dries. Dry product may be removed with chlorinated solvents (non-flammable) or Xylol (flammable).
- F. Hazard Statement: Harmful if swallowed or absorbed through skin. Causes moderate eye irritation. Prolonged skin contact may cause irritation. Acute overexposure to vapors may cause dizziness,

headache, nausea, and unconsciousness. Since emptied containers may retain product residue, follow label warnings even after container is empty.

### 3.04 CERTIFICATION

- A. At completion of the work submit certification of the National Air Duct Cleaners Association stating that work was performed in accordance with their standards.

END OF SECTION



## **SECTION 23 33 00 - AIR DUCT ACCESSORIES**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Backdraft and pressure relief dampers.
  - 2. Manual volume dampers.
  - 3. Control dampers.
  - 4. Fire dampers.
  - 5. Smoke dampers.
  - 6. Flange connectors.
  - 7. Turning vanes.
  - 8. Duct-mounted access doors.
  - 9. Flexible connectors.
  - 10. Duct accessory hardware.
- B. Related Requirements:
  - 1. Section 283000 "Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
  - 1. Product data showing compliance with ASHRAE 62.1.
  - 2. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances, and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Manual volume damper installations.
    - c. Control-damper installations.
    - d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
    - e. Wiring Diagrams: For power, signal, and control wiring.

#### 1.03 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### **PART 2 - PRODUCTS**

## 2.01 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

## 2.02 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G60 for indoor applications and G90 for exterior applications.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.03 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Warming and Ventilating; a Mestek Architectural Group company.
  - 2. Greenheck Fan Corporation.
  - 3. Lloyd Industries, Inc.
  - 4. Nailor Industries Inc.
  - 5. NCA Manufacturing, Inc.
  - 6. Pottorff.
  - 7. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2500 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: Hat-shaped, 0.063-inch-thick extruded aluminum or 0.05-inch-thick stainless steel, with welded corners or mechanically attached and mounting flange.
- F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.
- I. Blade Axles:
  - 1. Material: Stainless steel.
  - 2. Diameter: 0.20 inch.

- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Synthetic pivot bushings.
- M. Accessories:
  - 1. Adjustment device to permit setting for varying differential static pressure.
  - 2. Counterweights and spring-assist kits for vertical airflow installations.
  - 3. Screen Mounting: Rear mounted.
  - 4. Screen Material: Aluminum.
  - 5. Screen Type: Bird.
  - 6. 90-degree stops.
- N. Air Leakage: Class I – Not to exceed 8 CFM/FT<sup>2</sup> @ 4" w.g. AMCA Certified.

## 2.04 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Warming and Ventilating; a Mestek Architectural Group company.
    - b. Flexmaster U.S.A., Inc.
    - c. McGill AirFlow LLC.
    - d. Nailor Industries Inc.
    - e. Pottorff.
    - f. Ruskin Company.
  - 2. Standard leakage rating.
  - 3. Suitable for horizontal or vertical applications.
  - 4. Frames:
    - a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
    - b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  - 5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized steel, 0.064 inch thick.
  - 6. Blade Axles: Galvanized steel.
  - 7. Bearings:
    - a. Molded synthetic.
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  - 8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Warming and Ventilating; a Mestek Architectural Group company.
    - b. McGill AirFlow LLC.
    - c. Nailor Industries Inc.
    - d. Pottorff.
    - e. Ruskin Company.

2. Standard leakage rating.
  3. Suitable for horizontal or vertical applications.
  4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
  5. Blades:
    - a. Multiple or single blade.
    - b. Parallel or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
    - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
  6. Blade Axles: [Galvanized steel] [Stainless steel] [Nonferrous metal].
  7. Bearings:
    - a. [Oil-impregnated bronze] [Molded synthetic] [Stainless-steel sleeve].
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  8. Tie Bars and Brackets: Aluminum.
- C. Jackshaft:
1. Size: 1-inch diameter.
  2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
  2. Include center hole to suit damper operating-rod size.
  3. Include elevated platform for insulated duct mounting.

## 2.05 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Warming and Ventilating; a Mestek Architectural Group company.
  2. Arrow United Industries.
  3. Greenheck Fan Corporation.
  4. Lloyd Industries, Inc.
  5. McGill AirFlow LLC.
  6. Metal Form Manufacturing, Inc.
  7. Nailor Industries Inc.
  8. Pottorff.
  9. Ruskin Company.
  10. Tamco
  11. Young Regulator Company.
- B. Frames:
1. Hat, U, or Angle shaped.
  2. 0.05-inch thick stainless steel.
  3. Mitered and welded corners.
- C. Blades:

1. Multiple blade with maximum blade width of 6 inches.
  2. Opposed blade design.
  3. Aluminum.
  4. 0.0747-inch- thick dual skin.
  5. Blade Edging: Closed-cell neoprene.
  6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- D. Blade Axles: 1/2-inch-diameter; nonferrous metal; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg. F.
- E. Bearings:
1. Molded synthetic.
  2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  3. Thrust bearings at each end of every blade.
- F. Air Leakage: Class I – Not to exceed 8 CFM/FT<sup>2</sup> @ 4" w.g.. AMCA Certified.

## 2.06 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Warming and Ventilating; a Mestek Architectural Group company.
  2. Arrow United Industries.
  3. Greenheck Fan Corporation.
  4. Nailor Industries Inc.
  5. Pottorff.
  6. Ruskin Company.
  7. Vent Products Co., Inc.
- B. Type: Static; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2500-fpm velocity.
- D. Fire Rating: 1 ½ and 3 hours. Coordinate with wall rating.
- E. Frame: Curtain type with blades inside airstream for duct heights larger than 14" and curtain type with blades outside airstream for duct heights 14" and below; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.138 inch thick, as indicated, and of length to suit application.
  2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg. F rated, fusible links. Provide 10 % extra links to the owner.
- K. SET FIRE DAMPERS IN 20 GAUGE SLEEVES WITH BREAKAWAY CONNECTIONS TO THE DUCTWORK ON EACH SIDE. SEE STANDARD SMACNA DETAILS FOR INSTALLATION. DAMPERS INSTALLED INCORRECTLY WILL BE REQUIRED TO BE REMOVED AND REPLACED CORRECTLY.

- L. Provide 12" x 12" access door in ductwork for access to each damper. Label "FIRE DAMPER ACCESS" with 2" high stenciled letters.

## 2.07 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Warming and Ventilating; a Mestek Architectural Group company.
  2. Greenheck Fan Corporation.
  3. Nailor Industries Inc.
  4. Pottorff.
  5. Ruskin Company.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Shall be provided by the Fire Alarm Contractor / Electrical Contractor and installed by the Mechanical Contractor.
- D. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange.
- E. Blades: Roll-formed, horizontal, interlocking, 0.063-inch thick, galvanized sheet steel.
- F. Leakage: Class I.
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, 0.05-inch thick, galvanized sheet steel; length to suit wall or floor application [ with factory-furnished silicone calking].
- I. Damper Motors: two-position action.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
  3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
  4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
  5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg. F.
  6. Nonspring-Return Motors: For damper's larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
  7. Electrical Connection: 24 V.
- K. Accessories:
1. Auxiliary switches for signaling, fan control or position indication.  
Test and reset switches, damper mounted.

## 2.08 COMBINATION SMOKE/FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Warming and Ventilating; a Mestek Architectural Group company.
  - 2. Greenheck Fan Corporation.
  - 3. Nailor Industries Inc.
  - 4. Pottorff.
  - 5. Ruskin Company.
- B. General Requirements:
  - 1. Dampers shall be furnished with both the 1 1/2 hour (or 3 hour) UL label for fire dampers - UL 555 and the UL label for leakage resistance (smoke) - UL 555S.
  - 2. Refer to the requirements of Fire Dampers and Smoke Dampers for additional requirements.

## 2.09 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
- B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

## 2.10 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Aero-Dyne Sound Control Co.
  - 2. Ductmate Industries, Inc.
  - 3. Duro Dyne Inc.
  - 4. Elgen Manufacturing.
  - 5. Hardcast, Inc.
  - 6. METALAIRE, Inc.
  - 7. SEMCO LLC.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.

## 2.11 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Warming and Ventilating; a Mestek Architectural Group company.
  2. Ductmate Industries, Inc.
  3. Elgen Manufacturing.
  4. Flexmaster U.S.A., Inc.
  5. Greenheck Fan Corporation.
  6. McGill AirFlow LLC.
  7. Nailor Industries Inc.
  8. Pottorff.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
    - c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside handles.
    - d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside handles.

## 2.12 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. 3M.
  2. Ductmate Industries, Inc.
  3. Flame Gard, Inc.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg. F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

## 2.13 FLEXIBLE CONNECTORS

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



1. Ductmate Industries, Inc.
  2. Elgen Manufacturing.
  3. Hardcast, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5 ¾ inches wide attached to two strips of 2 ¾ -inch-wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd.
  2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  3. Service Temperature: Minus 40 to plus 200 deg. F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd.
  2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  3. Service Temperature: Minus 50 to plus 250 deg. F.

#### 2.14 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

#### 2.15 ABOVE THE ROOF DUCT CURBS

- A. Furnish and install - RPS Duct Mounting Pedestals as manufactured by RPS Products and Systems Corp., Bensenville, IL at all necessary specified points or as shown on drawings. The duct mounting pedestal shall include an equipment rail, a matching length steel slide channel attached to "U" shaped mounting brackets and secured to side of equipment rail with lag bolts. The duct mounting assembly shall have galvanized 18' long continuous threaded rods for 12" vertical adjustment, lateral adjust spacer bracket for 12" horizontal adjustment, and galvanized slide assembly.

#### 2.16 VOLUME DAMPER CONTROL - REMOTE EXTERNAL CONTROL

Applications: Drywall ceilings or where shown on drawings.

1. Location: In ductwork where required to control air flow or balance air systems.
2. Volume Damper Type: Opposed single blade round butterfly damper for external control, EPDM low leakage seals, scoop and spin-in type shell, Young Regulator Co. 5020 CC Series. Rectangular: #830-CC Series.
3. Leakage: 10 CFM maximum at 4" s.p. for 4 square dampers.
4. Material: Galvanized steel in galvanized steel ductwork, extruded aluminum in aluminum ductwork.
5. Controls: Bowden Cable Control Kit 270-896C to include hardware, for ceiling mounting in conjunction with external control of round or rectangular dampers, flush

7/8" diameter cold rolled steel cover is zinc plated for painting, 12" wrench (damper adjustments), metal clad control cable.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 7. At each change in direction and at maximum 50-foot spacing.
  - 8. Upstream from turning vanes.
  - 9. Upstream or downstream from duct silencers.
  - 10. Control devices requiring inspection.
  - 11. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.

3. Head and Hand Access: 18 by 10 inches.
  4. Head and Shoulders Access: 21 by 14 inches.
  5. Body Access: 25 by 14 inches.
  6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers or light troffer boots to ducts with maximum 10 feet lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. Install duct test holes where required for testing and balancing purposes.
- Q. Install volume damper control – remote external control when balancing dampers are located above in accessible ceilings similar to gypsum board.

### 3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
  2. Inspect locations of access doors and verify that purpose of access door can be performed.
  3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  4. Inspect turning vanes for proper and secure installation.

END OF SECTION

## **SECTION 23 33 46 - FLEXIBLE DUCTS**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Insulated supply flexible ducts.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
1. Product data showing compliance with ASHRAE 62.1.
  2. Product Data: For adhesives and sealants, indicating VOC content.
  3. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
  4. Laboratory Test Reports: For Insulation, indicating compliance with requirements for low-emitting materials.
  5. Product Data: For insulation, indicating that R-values comply with tables in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."
- C. Shop Drawings: For flexible ducts.
1. Include plans showing locations and mounting and attachment details.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

### **PART 2 - PRODUCTS**

#### 2.01 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
- D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

#### 2.02 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. Flex-Tek Group.
  - 3. McGill AirFlow LLC.
  - 4. Thermafex.
  - 5. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene [aluminized] vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 10-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 210 deg. F.
  - 4. Insulation R-Value: Comply with ASHRAE/IES 90.1 - R4.2 in conditioned space, R8.0 in unconditioned space/outdoors.
  - 5. Comply with 25/50 flame spread and smoke density ratings.

### 2.03 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Flexible ducts are not acceptable above inaccessible ceilings.
- B. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- C. Applies to supply ductwork only. Exhaust and return ductwork to be rigid ductwork.
- D. Flexible air connectors and flexible ducts shall not be used to make 90 degree or greater.
- E. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- F. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- G. Connect diffusers or light troffer boots to ducts with maximum 10'-0" lengths of flexible duct clamped or strapped in place.
- H. Connect flexible ducts to metal ducts with liquid adhesive plus tape.
- I. Install duct test holes where required for testing and balancing purposes.
- J. Installation:
  - 1. Install ducts fully extended.
  - 2. Do not bend ducts across sharp corners.
  - 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
  - 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
  - 5. Install flexible ducts in a direct line, without sags, twists, or turns.

K. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1 ½ inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION

## **SECTION 23 34 16 - CENTRIFUGAL HVAC FANS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes: For each product.
1. Backward-inclined centrifugal fans.
  2. Forward-curved centrifugal fans.

#### **1.02 ACTION SUBMITTALS**

- A. Product Data:
1. Include rated capacities, furnished specialties, and accessories for each fan.
  2. Certified fan performance curves with system operating conditions indicated.
  3. Certified fan sound-power ratings.
  4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  5. Material thickness and finishes, including color charts.
  6. Dampers, including housings, linkages, and operators.
- B. Shop Drawings:
1. Include plans, elevations, sections, and attachment details.
  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. Include diagrams for power, signal, and control wiring.
  4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

#### **1.03 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- B. Field quality-control reports.

#### **1.04 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

#### **1.05 MAINTENANCE MATERIAL SUBMITTALS**

- A. Belts: Two set(s) for each belt-driven unit.

## **PART 2 - PRODUCTS**

### 2.01 PERFORMANCE REQUIREMENTS

- A. Refer to drawings for performance requirements.

### 2.02 BACKWARD-INCLINED CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acme Engineering & Manufacturing Corp.
  2. Greenheck Corporation
  3. Loren Cook Company.
  4. New York Blower Company (The).
- B. Description:
1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
  2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
  3. Factory-installed and -wired disconnect switch.
- C. Housings:
1. Formed panels to make curved-scroll housings with shaped cutoff.
  2. Panel Bracing: Steel angle or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
  3. Horizontally split, bolted-flange housing.
  4. Spun inlet cone with flange.
  5. Outlet flange.
- D. Backward-Inclined Wheels:
1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades, and fastened to shaft with set screws.
  2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.
- E. Shafts:
1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
  2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
  3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- F. Grease-Lubricated Shaft Bearings:
1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
- G. Belt Drives:



1. Factory mounted, with adjustable alignment and belt tensioning.
  2. Service Factor Based on Fan Motor Size: 1.5.
  3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
  4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
  5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
  6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
  7. Motor Mount: Adjustable for belt tensioning.
- H. Accessories:
1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
  2. Scroll Drain Connection: NPS 1-inch steel pipe coupling welded to low point of fan scroll.
  3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
  4. Inlet Screens: Grid screen of same material as housing.
  5. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
  6. Spark-Resistant Construction: AMCA 99.
  7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
  8. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

### 2.03 FORWARD-CURVED CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acme Engineering & Manufacturing Corp.
  2. Greenheck Corporation
  3. Loren Cook Company.
  4. New York Blower Company (The).
- B. Description:
1. Factory fabricated, assembled, tested, and finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
  2. Deliver fans as factory assembled units, to the extent allowable by shipping limitations.
  3. Factory installed and wired disconnect switch.
- C. Housings:
1. Formed panels to make curved-scroll housings with shaped cutoff.
  2. Panel Bracing: Steel angle or channel iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
  3. Horizontally split, bolted-flange housing.

4. Spun inlet cone with flange.
5. Outlet flange.
- D. Forward-Curved Wheels:
  1. Black-enameled or galvanized-steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow.
  2. Mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.
- E. Shafts:
  1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
  2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
  3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- F. Grease-Lubricated Shaft Bearings:
  1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
- G. Belt Drives:
  1. Factory mounted, with adjustable alignment and belt tensioning.
  2. Service Factor Based on Fan Motor Size: 1.5.
  3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
  4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
  5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
  6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
  7. Motor Mount: Adjustable for belt tensioning.
- H. Accessories:
  1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
  2. Scroll Drain Connection: NPS 1-inch steel pipe coupling welded to low point of fan scroll.
  3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
  4. Inlet Screens: Grid screen of same material as housing.
  5. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
  6. Spark-Resistant Construction: AMCA 99.
  7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.

## 2.04 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install centrifugal fans level and plumb.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Equipment Mounting:
  - 1. Install centrifugal fans on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in the architectural specifications.
  - 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Curb Support: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction. [ Secure units to curb support with anchor bolts.]
- F. Unit Support: Install centrifugal fans level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.
- G. Isolation Curb Support: Install centrifugal fans on isolation curbs, and install flexible duct connectors and vibration isolation.
  - 1. Comply with requirements in Section 233300 "Air Duct Accessories" for flexible duct connectors.
  - 2. Comply with requirements in Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
- H. Install units with clearances for service and maintenance.
- I. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

### **3.02 CONNECTIONS**

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

### 3.03 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. Verify that shipping, blocking, and bracing are removed.
  2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  3. Verify that cleaning and adjusting are complete.
  4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  5. Adjust belt tension.
  6. Adjust damper linkages for proper damper operation.
  7. Verify lubrication for bearings and other moving parts.
  8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  9. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
  10. Remove and replace malfunctioning units and retest as specified above.
  11. Kitchen exhaust fan shall be installed within the requirements of NFPA.
  12. Any steel shall be primed with Rustoleum and coated with 2 coats of enamel paint.
- B. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

## **SECTION 23 34 23 - HVAC POWER VENTILATORS**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

A. Section Includes:

1. Centrifugal roof ventilators.
2. Ceiling-mounted ventilators.
3. In-line centrifugal fans.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  2. Wiring Diagrams: For power, signal, and control wiring.
  3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  4. Design Calculations: Calculate requirements for selecting vibration isolators [ and seismic restraints] and for designing vibration isolation bases.

#### 1.03 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.04 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

### **PART 2 - PRODUCTS**

#### 2.01 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Greenheck Fan Corporation, Loren Cook, PennBarry Housing: Removable,

spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units (Where indicated on drawings): Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
  2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- B. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- C. Belt Drives:
1. Resiliently mounted to housing.
  2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
  3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
  4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
  5. Fan and motor isolated from exhaust airstream.
- D. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  2. Provide variable frequency drive (VFD). The motor shall be rated for use with a VFD.
  3. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
  4. Bird Screens: Removable, 1/2-inch mesh, aluminum, or brass wire.
  5. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  6. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops. Dampers shall be insulated low leakage.
- E. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Overall Height: 8 inches.
  2. Sound Curb: Curb with sound-absorbing insulation.
  3. Pitch Mounting: Manufacture curb for roof slope.
  4. Metal Liner: Galvanized steel.
  5. Mounting Pedestal: Galvanized steel with removable access panel.
  6. Vented Curb: Unlined with louvered vents in vertical sides.

## 2.02 CEILING-MOUNTED VENTILATORS

- A. Commercial Application Manufacturers: Greenheck Fan Corporation, Loren Cook, PennBarry.
- B. Residential Application (Apartments, Houses, Condominiums) Manufacturers: Panasonic, Nutone, and Broan.
- C. Housing: Steel, lined with acoustical insulation.
- D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- E. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for

motor plug-in.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
4. Motion Sensor: Motion detector with adjustable shutoff timer.
5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
6. Filter: Washable aluminum to fit between fan and grille.
7. Isolation: Rubber-in-shear vibration isolators.
8. Manufacturer's standard roof jack or wall cap, and transition fittings.
9. Energy Star Fans
  - a. Multi-speed module to allow the fan to run continuously on low speed and ramp up to a higher speed.
  - b. Condensate Sensor / humidity sensor switch
  - c. Motion Sensor Control

2.03 IN-LINE CENTRIFUGAL FANS

- A. Manufacturers: Greenheck Fan Corporation, Loren Cook, PennBarry.
- B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel and inlet cone.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- F. Accessories:
  1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  2. Provide variable frequency drive (VFD). The motor shall be rated for use with a VFD.
  3. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
  4. Companion Flanges: For inlet and outlet duct connections.
  5. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
  6. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.04 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Enclosure Type: Totally enclosed, fan cooled.

## 2.05 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Equipment Mounting:
  - 1. Install power ventilators on cast-in-place concrete equipment base(s).
  - 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- B. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. Refer to architectural specification sections for installation of roof curbs.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install units with clearances for service and maintenance.
- F. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."
- G. The ceiling exhaust fan shall be supported from construction above, not ceiling tiles or ceiling runners or grids. Connect to ductwork and extend ductwork to the perimeter of the building.
- H. Each fan shall be connected to ductwork with a flexible connection.
- I. Kitchen exhaust fan shall be installed within the requirements of NFPA.
- J. Any steel shall be primed with Rustoleum and coated with 2 coats of enamel paint.

### 3.02 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to in electrical sections.
- D. Connect wiring according to in electrical sections.

### 3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: On systems greater than 5,000 CFM, engage a factory-authorized service representative to inspect components, assemblies, and



equipment installations, including connections, and to assist in testing.

- B. Tests and Inspections:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 3. Verify that cleaning and adjusting are complete.
  - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  - 5. Adjust belt tension.
  - 6. Adjust damper linkages for proper damper operation.
  - 7. Verify lubrication for bearings and other moving parts.
  - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
  - 10. Shut unit down and reconnect automatic temperature-control operators.
  - 11. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

#### 3.04 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION

## **SECTION 23 36 00 - AIR TERMINAL UNITS**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
1. Shutoff, single-duct air terminal units.
  2. Parallel, fan-powered air terminal units.
  3. Series, fan-powered air terminal units.
  4. Casing liner.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of air terminal unit.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For air terminal units.
1. Include plans, elevations, sections, and mounting details.
  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. Include diagrams for power, signal, and control wiring.
  4. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
- B. Field quality-control reports.

#### 1.04 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### **PART 2 - PRODUCTS**

#### 2.01 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and

- Equipment" and Section 7 - "Construction and System Start-up."  
C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

## 2.02 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers:
1. Carnes Co.
  2. ENVIRO-TEC
  3. Johnson Controls, Inc.
  4. METALAIRE, Inc.
  5. Nailor Industries, Inc.
  6. Price Industries
  7. Titus; brand of Johnson Controls
  8. Trane
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: galvanized steel, single wall.
1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass or flexible elastomeric duct liner.
  2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  3. Air Outlet: S-slip and drive connections, size matching inlet size
  4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
  5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from zero to 140 deg F shall be impervious to moisture and fungus, shall be suitable for 10-inch wg static pressure, and shall be factory tested for leaks.
- E. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
  2. Damper Position: Normally open
- F. Attenuator Section: 0.034-inch steel sheet
1. Attenuator Section Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass or flexible elastomeric duct liner.
  2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- G. Multioutlet Attenuator Section: Collars, each with locking butterfly balancing damper.
- H. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- I. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. SCR controlled.
  2. Access door interlocked disconnect switch.
  3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
  4. Nickel chrome 80/20 heating elements.
  5. Airflow switch for proof of airflow.
  6. Fan interlock contacts.
  7. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
  8. Magnetic contactor for each step of control (for three-phase coils).
- J. Control devices shall be compatible with temperature controls system specified in Section 230933 Building Automation System..
1. Electric Damper Actuator: 24 V, powered open, spring capacitous return.
  2. Electronic Damper Actuator: 24 V, powered open, spring/capacitous return.
  3. Electric Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit, and space temperature set point.
  4. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit.
  5. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg; and shall have a multipoint velocity sensor at air inlet.
  6. Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
    - a. Occupied and unoccupied operating mode.
    - b. Remote reset of airflow or temperature set points.
    - c. Adjusting and monitoring with portable terminal.
    - d. Communication with temperature-control system specified in Section 230933 "Building Automation System."
  7. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.
- K. Controls:
1. Suitable for operation with duct pressures between 0.25- and 3.0-inch wg inlet static pressure.
  2. System-powered, wall-mounted thermostat.
- L. Control Sequences:
1. Refer to Section 230933 "Building Automation System".

## 2.03 PARALLEL FAN-POWERED AIR TERMINAL UNITS

- A. Manufacturers:
1. Carnes Co.
  2. ENVIRO-TEC
  3. Johnson Controls, Inc.
  4. METALAIRE, Inc.
  5. Nailor Industries, Inc.
  6. Price Industries
  7. Titus; brand of Johnson Controls

8. Trane
- B. Configuration: Volume-damper assembly and fan in parallel arrangement inside unit casing with control components inside a protective metal shroud. Designed for quiet operation. Low-profile design.
- C. Casing: galvanized steel, single wall.
1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass or flexible elastomeric duct liner.
  2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
  3. Air Outlet: S-slip and drive connections.
  4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
  5. Fan: Forward-curved centrifugal, located at plenum air inlet.
  6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
  2. Damper Position: Normally open
- E. Velocity Sensors: Multipoint array with velocity sensors.
- F. Motor:
1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
- G. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Material: Polyurethane foam having 70 percent arrestance and 3 MERV.
  2. Material: Glass fiber treated with adhesive; having 80 percent arrestance and 5 MERV.
  3. Material: Pleated cotton-polyester media having 90 percent arrestance and 7 MERV.
  4. Thickness: 2 inches.
- H. Attenuator Section: 0.034-inch galvanized steel sheet.
1. Attenuator Section Liner: Comply with requirements in "Casing Liner" Article for flexible elastomeric duct liner.
  2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- I. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
1. Location: Plenum air inlet.
- J. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
1. Location: Plenum air inlet.
  2. SCR controlled.
  3. Access door interlocked disconnect switch.

4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
  5. Nickel chrome 80/20 heating elements.
  6. Airflow switch for proof of airflow.
  7. Fan interlock contacts.
  8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
  9. Magnetic contactor for each step of control (for three-phase coils).
- K. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
  2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
  3. Disconnect Switch: Factory-mounted, fuse type.
- L. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- M. Control devices shall be compatible with temperature controls system specified in Section 230933 "Building Automation System."
1. Electric Damper Actuator: 24 V, powered open, spring or capacitive return.
  2. Electronic Damper Actuator: 24 V, powered open, spring capacitive return.
  3. Electric Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit and Celsius, and space temperature set point.
  4. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.
  5. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg; and shall have a multipoint velocity sensor at air inlet.
  6. Terminal Unit Controller: Pressure-independent, VAV controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
- N. Control Sequences:
1. Refer to Section 230933 "Building Automation System."

## 2.04 SERIES FAN-POWERED AIR TERMINAL UNITS

- A. Manufacturers:
1. Carnes Co.
  2. ENVIRO-TEC
  3. Johnson Controls, Inc.
  4. METALAIRE, Inc.
  5. Nailor Industries, Inc.
  6. Price Industries
  7. Titus; brand of Johnson Controls
  8. Trane
- B. Unit casing with control components inside a protective metal shroud for installation above a

- ceiling and within a raised access floor.
1. Designed for quiet operation.
  2. Low-profile design.
- C. Casing: galvanized steel, single wall.
1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass or flexible elastomeric duct liner.
  2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
  3. Air Outlet: S-slip and drive connections.
  4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
  5. Fan: Forward-curved centrifugal.
  6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
  2. Damper Position: Normally open
- E. Velocity Sensors: Multipoint array with velocity sensors in air inlets and air outlets.
- F. Motor:
1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
- G. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Material: Polyurethane foam having 70 percent arrestance and 3 MERV.
  2. Material: Glass fiber treated with adhesive; having 80 percent arrestance and 5 MERV.
  3. Material: Pleated cotton-polyester media having 90 percent arrestance and 7 MERV.
- H. Attenuator Section: 0.034-inch galvanized steel sheet.
1. Attenuator Section Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass or flexible elastomeric duct liner.
  2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- I. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- J. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
1. SCR controlled.
  2. Access door interlocked disconnect switch.
  3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
  4. Nickel chrome 80/20 heating elements.
  5. Airflow switch for proof of airflow.

6. Fan interlock contacts.
  7. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
  8. Magnetic contactor for each step of control (for three-phase coils).
- K. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
  2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
  3. Disconnect Switch: Factory-mounted, fuse type.
- L. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- M. Control devices shall be compatible with temperature controls system specified in Section 230933 "Building Automation System".
1. Electric Damper Actuator: 24 V, powered open, spring or capacitive return.
  2. Electronic Damper Actuator: 24 V, powered open, spring or capacitive return.
  3. Electric Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit and Celsius, and space temperature set point.
  4. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.
  5. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg; and shall have a multipoint velocity sensor at air inlet.
  6. Terminal Unit Controller: Pressure-independent, VAV controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
- N. Control Sequences:
1. Refer to Section 230933 "Building Automation System."

## 2.05 CASING LINER

- A. Casing Liner: Fibrous-glass duct liner, complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  2. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
- B. Casing Liner: Flexible elastomeric duct liner fabricated of preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Minimum Thickness: 3/4 inch.
  2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an



NRTL.

3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

## 2.06 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to AHRI 880.
  1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

## PART 3 - EXECUTION

### 3.01 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.02 TERMINAL UNIT INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units' level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.
- D. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
- E. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

- F. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.
- G. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."
- H. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.03 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
  - 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. Air terminal unit will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

Contractor and Manufacturer Responsibilities:

ITEM	CONNECTED BY	FURNISHED BY	MOUNTED BY
VAV Box	Mechanical Contractor	Mechanical Contractor	Mechanical Contractor
Damper Actuator	ATC Contractor	VAV Mfr.	VAV Mfr.
Air-Flow Pickup	VAV Mfr.	VAV Mfr.	VAV Mfr.
Duct Heater	VAV Mfr.	VAV Mfr.	VAV Mfr.
Safeties	VAV Mfr.	VAV Mfr.	VAV Mfr.
Contactors	VAV Mfr.	VAV Mfr.	VAV Mfr.
Hot Water Coil	VAV Mfr.	VAV Mfr.	Mechanical Contractor
Control Valve	ATC Contractor	Mechanical Contractor	Mechanical Contractor
Valve Actuator		ATC Contractor (4)	ATC Contractor
VAV Box Fan Relay	VAV Mfr.	VAV Mfr.	VAV Mfr.
24-V Transformer (5)	VAV Mfr.	VAV Mfr.	
a. Low Voltage Side			VAV Mfr.
b. Line Voltage Side			See Note 2
Air-Flow Transducer	ATC Contractor	ATC Contractor	See Note 3
Wall Module	ATC Contractor	ATC Contractor	ATC Contractor
Digital Controller	ATC Contractor	VAV Mfr.	Per Above

(1) Mechanical contractor makes ductwork and piping connections.

- (2) By electrical contractor (preferably) or ATC Contractor, per plans and specs.
- (3) VAV MFR connects air-flow pick-up, ATC Contractor connects wiring (factory mounted and wired on to controller).
- (4) If not integral to control valve.
- (5) If the terminal has no fan, the 24 volt power source should be furnished, mounted, and connected by the ATC Contractor.

#### 3.04 DEMONSTRATION

- A. Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION

## SECTION 23 37 13.13 - AIR DIFFUSERS

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Louver face diffusers.
3. Linear bar diffusers.
4. Linear slot diffusers.
5. Vav Diffusers
6. Louvers
7. Air Filters
8. Sound Traps
9. Ceiling Opening Protection
10. Air Blenders
11. Drum Louvers

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.
3. The SMACNA Low Velocity Duct Manual, ASHRAE Handbooks, International Mechanical Code, and NFPA Pamphlet 90A shall apply to this work.
4. Refer to Section 23 31 13 Ductwork.

#### 1.02 WORK INCLUDED

- A. Provide labor, material, equipment, and supervision necessary to install a complete air handling system with all supply and return distribution devices as indicated on the drawings and specified herein.
- B. Contractor is to furnish and install a volume damper in all supply, return, exhaust, and outside air branch ductwork. If these are omitted from the drawings, the contractor is to make an allowance to install one.

#### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Submit manufacturer's literature and performance data of equipment and devices for review.
- C. Samples; Furnish at request of A/E.

#### 1.04 QUALITY ASSURANCE

- A. Verify that all equipment is installed in accordance with manufacturer's warranty

requirements.

- B. Provide adequate supervision of labor force to see that installations are correct.

## **PART 2 - PRODUCTS**

### **2.01 RECTANGULAR AND SQUARE CEILING DIFFUSERS**

- A. Furnish and install terminal air diffusers of the size and capacity indicated on the drawings.
- B. Room terminal air velocity shall not exceed 50 fpm. NC level shall not exceed 40. Air static pressure drop shall not exceed 0.10" wg.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Anemostat
  - 2. Carnes Company.
  - 3. Hart & Cooley Inc.
  - 4. Krueger.
  - 5. METALAIRE, Inc.
  - 6. Nailor Industries Inc.
  - 7. Price Industries.
  - 8. Titus.
  - 9. Tuttle & Bailey.
- D. Devices shall be specifically designed for variable-air-volume flows.
- E. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
- F. Finish: Baked enamel, white
- G. Face Size: 12 by 12 inches for up to 150 cfm, 24 by 24 inches for all other size.
- H. Face Style: Plaque.
- I. Mounting: Each diffuser shall have a mounting flange specifically selected for the particular type of ceiling finish. Contractor to coordinate with architectural ceiling details.
- J. Pattern: Fixed
- K. Dampers: Radial opposed blade
- L. Accessories:
  - 1. Equalizing grid.
  - 2. Plaster ring.
  - 3. Wire guard.
  - 4. Sectorizing baffles.
  - 5. Operating rod extension.
- M. Performance shall be tested in accordance with ASHRAE 70-2006 (RA 2011).

### **2.02 LOUVER FACE DIFFUSERS**

- A. Furnish and install terminal air diffusers of the size and capacity indicated on the drawings.
- B. Room terminal air velocity shall not exceed 50 fpm. NC level shall not exceed 40. Air static pressure drop shall not exceed 0.10" wg
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the

following:

1. Anemostat
  2. Carnes Company.
  3. METALAIRE, Inc.
  4. Nailor Industries Inc.
  5. Price Industries.
  6. Titus.
  7. Tuttle & Bailey.
- D. Devices shall be specifically designed for variable-air-volume flows.
- E. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
- F. Finish: Baked enamel, white
- G. Face Size: 24" x 24"
- H. Mounting: Each diffuser shall have a mounting flange specifically selected for the particular type of ceiling finish. Contractor to coordinate with architectural ceiling details.
- I. Pattern: Fixed
- J. Pattern: One-way, Two-way, Two-way corner, Three-way or Four-way core style.
- K. Dampers: Radial opposed blade
- L. Accessories:
1. Square to round neck adaptor.
  2. Adjustable pattern vanes.
  3. Throw reducing vanes.
  4. Equalizing grid.
  5. Plaster ring.
  6. Wire guard.
  7. Sectorizing baffles.
  8. Operating rod extension.
- M. Performance shall be tested in accordance with ASHRAE 70-2006 (RA 2011).

### 2.03 LINEAR BAR DIFFUSERS

- A. Furnish and install linear type air diffusers of the lengths and capacities indicated on the drawings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Anemostat Products; a Mestek company.
  2. Carnes Company.
  3. Krueger.
  4. METALAIRE, Inc.
  5. Nailor Industries Inc.
  6. Price Industries.
  7. Titus.
  8. Tuttle & Bailey.
- C. Devices shall be specifically designed for variable-air-volume flows.
- D. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
- E. Finish: Baked enamel, white
- F. Wide Core Spacing Arrangement: 1/8-inch- thick blades spaced 1/2 inch apart; zero degree

deflection. Pencil-Proof Core Spacing Arrangement: 3/16-inch- thick blades spaced 7/16 inch apart; zero deflection.

- G. One or Two-Way Deflection Vanes: Extruded construction adjustable louvers with removable core.
- H. Frame: 1 inch wide.
- I. Mounting Frame: Each diffuser shall have a mounting flange specifically selected for the particular type of ceiling finish. Contractor to coordinate with architectural ceiling details.
- J. Mounting: Countersunk screw.
- K. Damper Type: Adjustable opposed-blade assembly
- L. Accessories: Plaster frame for drywall or plaster ceilings

#### 2.04 LINEAR SLOT DIFFUSERS

- A. Furnish and install linear type air diffusers of the lengths and capacities indicated on the drawings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Anemostat Products; a Mestek company.
  2. Carnes Company.
  3. Hart & Cooley Inc.
  4. Krueger.
  5. METALAIRE, Inc.
  6. Nailor Industries Inc.
  7. Price Industries.
  8. Titus.
  9. Tuttle & Bailey.
- C. Devices shall be specifically designed for variable-air-volume flows.
- D. Material - Shell: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
- E. Material - Pattern Controller and Tees: Aluminum.
- F. Finish - Face and Shell: Baked enamel, black.
- G. Finish - Pattern Controller: Baked enamel, black.
- H. Finish - Tees: Baked enamel, white.
- I. Slot Width: 1 inch
- J. Number of Slots: One, Two, Three or Four
- K. Length: As noted in the Air Device Schedule
- L. Accessories: Plaster frame for drywall or plaster ceilings

#### 2.05 VAV DIFFUSERS

- A. Furnish and install self-contained VAV air diffusers of the sizes and capacities indicated on the drawings.
- B. Diffusers shall have a 24" x 24" face with round neck inlet. Diffusers shall have internal mechanism to sense room temperature and position a diffusion blade in response to room temperature. Unit shall be capable of maintaining space temperature within a 2 degree temperature variation. Units shall have automatic changeover from heating to cooling and in reverse.

- C. Units shall have a 5 year warranty.
- D. Diffusers shall be type TF-CW Therma-fuser as manufactured by Acutherm, Inc.

## 2.06 LOUVERS

- A. Louvers shall be extruded aluminum with 12 gauge blades and frames 2" deep up to 12" in height. 4" deep from 12" to 36" in height, and 6" deep above 36" in height. Louvers shall be storm proof design and shall not pull rain through the blades at the capacity required by the system.
- B. Furnish a bird screen on each louver mounted at the inside face.
- C. Frames shall be miter welded with reinforced corners.
- D. Louver finish shall be determined by the architect. Contractor to coordinate.
- E. Manufacturer: American Warming and Ventilating, Ruskin, Greenheck and Pottorff, United Enertech.

## 2.07 AIR FILTERS

- A. Refer to drawings and schedules for certain air filtration requirements for various systems.
- B. These filters are to be installed in air handling equipment if the equipment is capable of receiving them. If not, the contractor shall install the filters in a filter frame with gasketed doors on the entering side of the unit. The filter frame in either case shall provide an airtight fit with gaskets.
- C. Furnish and install a red oil manometer for each filter of efficiency of 30 percent or more and with a range of 0 to 30 inches water gage. Gauge to be Dwyer Instruments, Inc.
- D. The filter shall meet a minimum of MERV (xx) @ 2000 cfm (500 fpm) per ASHRAE Standard 52.2-2007 and shall be required to meet the same MERV-A value when tested per "Appendix j" of the aforementioned Standard. A filter with a MERV -A value lower than the MERV rating is not acceptable.
- E. Manufacturers: CAMFIL/FARR Co., ECO Air Filters, Flanders, American Air Filter.

## 2.08 SOUND TRAPS

- A. Furnish and install prefabricated sound traps of the size and capacity indicated.
- B. Outer casing of 22 gauge galvanized steel, lock formed seams, 26 gauge galvanized steel perforated liners, inorganic mineral, or fiberglass fill.
- C. Manufacturer: I.A.C., SEMCO, BRD Noise & Vibration Control, Inc., Vibro Acoustics or as indicated on drawings.
- D. Contractor to provide three duct diameters on the inlet side of the sound traps.

## 2.09 CEILING OPENING PROTECTION

- A. Furnish and install round, square, or rectangular ceiling radiant dampers for all supply, return, exhaust registers, grilles, and diffusers where indicated on the drawings. These grilles, registers, and diffusers are to be white painted steel.
- B. Dampers shall be double blade "butterfly" type with 21 ga. galvanized steel blades in a 14 ga. galvanized steel combination pivot clamp/blade thrust bearing. Frame shall be minimum 21 ga.-maximum 16 ga. steel, one piece miter cut tabbed and locked frame with U.L. Label.
- C. Furnish and install a ceramic insulating blanket for lay-in diffusers.



- D. Manufacturers: Prefco, Phillips-Aire, Nailor-Hart
- E. Field fabricated or shop fabricated systems are not acceptable.

#### 2.10 AIR BLENDERS

- A. Air Blenders to be manufactured by Blender Products, Inc., Denver, Colorado. Units shall be of the type, size, pressure drop, and capacity as scheduled and shown on drawings. All units shall be factory built and tested and shall be installed in strict accordance with manufacturer's recommendations and as shown on drawings.
- B. Joints shall be sealed with duct joint sealant.
- C. Volume dampers shall be easily operable from the space.
- D. Exposed faces shall be clean and free of any smudges, marks, or scratches. Touch up as necessary.
- E. Units shall be completely fixed devices, with no moving parts. Standard fabrication shall be of .080" thick aluminum, and all welded construction and installed per the manufacturer's recommendations. The mixing device shall mix the two airstreams to yield a maximum standard deviation of 6 degrees F from the mixed air temperature.
- F. Air Blenders located on discharge side of fans to blow-through type systems shall also function as diffusers in maintaining even velocities over entire face of coils.
- G. The manufacturer of the air mixing devices shall be able to furnish a list of over 500 proven installations in active service.

#### 2.11 DRUM LOUVERS

- A. Furnish and install the drum louvers of the size and capacity indicated on the drawings.
- B. Drum louvers shall be extruded aluminum.
- C. Drum louvers shall have opposed blade damper, adjustable louver vanes, 60° angular adjustment control (30° up and 30° down).
- D. Custom finish is selected by the architect.
- E. Coordinate ductwork opening size with drum louver size.
- F. Manufacturers: Krueger "DPL" Series or prior approved equal.

### **PART 3 - EXECUTION**

#### 3.01 INSTALLATION

- A. Install diffusers level and plumb.
- B. Supports: Galvanized steel per SMACNA.
- C. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- D. Install diffusers with airtight connections to ducts and to allow service and maintenance of

dampers, air extractors, and fire dampers.

### 3.02 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

### 3.03 LOUVERS

- A. Louvers shall be set plumb in wall openings left by general contractor.
- B. Coordinate openings with G. C.
- C. Louvers shall be anchored in masonry construction.
- D. Frames shall be caulked watertight. Color of caulking shall be acceptable to the architect.
- E. Connections to wall louvers shall be sloped down to louver connection to prevent water draining into interior.

### 3.04 FILTERS

- A. All filters shall be clean prior to acceptance by the owner. Renewable media filters shall be replaced with new filters. Cleanable filters shall be removed and cleaned just prior to acceptance.
- B. Provide one spare set of replaceable filters for each system to the owner prior to acceptance of the work.

### 3.05 CEILING OPENING PROTECTION

- A. Each supply, return, and exhaust opening in a ceiling shall be protected in accordance with UL Laboratories for the integrity of the fire stopping rating. This will require that each opening be suitably protected throughout the building.
- B. Dampers shall bear the U.L. Label and shall be installed in accordance with the U.L. Standards and manufacturer's instructions.
- C. A ceramic blanket shall be attached to diffuser neck and duct using steel duct clamp or 16 ga. Steel wire. Blanket shall be supported from 4 corners using 12 swg wire.

END OF SECTION

## **SECTION 23 37 13.23 - REGISTERS AND GRILLES**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Adjustable blade face registers and grilles.
  - 2. Fixed face registers and grilles.
- B. Related Requirements:
  - 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
  - 2. Section 233713.13 "Air Diffusers" for various types of air diffusers.
  - 3. The SMACNA Low Velocity Duct Manual, ASHRAE Handbooks, International Mechanical Code, and NFPA Pamphlet 90A shall apply to this work.
  - 4. Refer to Section 23 31 13 Ductwork.

#### 1.02 WORK INCLUDED

- A. Provide labor, material, equipment, and supervision necessary to install a complete air handling system with all supply and return distribution devices as indicated on the drawings and specified herein.
- B. Contractor is to furnish and install a volume damper in all supply, return, exhaust, and outside air branch ductwork. If these are omitted from the drawings, the contractor is to make an allowance to install one.

#### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Submit manufacturer's literature and performance data of equipment and devices for review.
- C. Samples; Furnish at request of A/E.

#### 1.04 QUALITY ASSURANCE

- A. Verify that all equipment is installed in accordance with manufacturer's warranty requirements.
- B. Provide adequate supervision of labor force to see that installations are correct.

### **PART 2 - PRODUCTS**

#### 2.01 REGISTERS

- A. Furnish and install terminal air registers of the size and capacities indicated on the drawings.

B. Adjustable Blade Face Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anemostat Products; a Mestek company.
  - b. Carnes Company.
  - c. Krueger.
  - d. METALAIRE, Inc.
  - e. Nailor Industries Inc.
  - f. Price Industries.
  - g. Titus.
  - h. Tuttle & Bailey.
2. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal, spaced -1/2 inch centers for return and exhaust and 3/4 inch centers for supply, single set at 45 degrees for return or exhaust and double deflection adjustable for supply. Reinforced corners, mitered.
5. Core Construction: Removable.
6. Rear-Blade Arrangement: Vertical, spaced 1/2 inch centers for return and exhaust and 3/4 inch centers for supply.
7. Frame: 1 inch wide.
8. Mounting Frame: Provide separable frames in drywall, plaster, or masonry construction as noted on the architectural drawings.
9. Mounting: Countersunk screw
10. Damper Type: Adjustable opposed blade

C. Fixed Face Register

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anemostat Products; a Mestek company.
  - b. Carnes Company.
  - c. Krueger.
  - d. Nailor Industries Inc.
  - e. Price Industries.
  - f. Titus.
  - g. Tuttle & Bailey.
2. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal, spaced 1/2 inch centers for return and exhaust and 3/4 inch centers for supply, single set at 45 degrees for return or exhaust and double deflection adjustable for supply. Reinforced corners, mitered.
5. Face Arrangement: Perforated core.
6. Core Construction: Removable.
7. Frame: 1 inch wide.
8. Mounting Frame: Provide separable frames in drywall, plaster, or masonry construction as noted on the architectural drawings.
9. Mounting: Countersunk screw
10. Damper Type: Adjustable opposed blade

- 11. Accessory: Filter.
- D. Furnish and install turning vanes for connections to ducts.
- E. Where registers are located low near floor, they shall be heavy duty 14 gauge steel with fixed 45 degree blades on 1/2" centers. In damp areas, they shall be extruded aluminum.
- F. Where drawings indicate linear return grilles, they shall be linear extruded aluminum with 1/8" bars 3/4" long on 1/4" centers.

## 2.02 GRILLES

- A. Furnish and install terminal air registers of the size and capacities indicated on the drawings.
- B. Adjustable Blade Face Grille:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anemostat Products; a Mestek company.
    - b. Carnes Company.
    - c. Krueger.
    - d. METALAIRE, Inc.
    - e. Nailor Industries Inc.
    - f. Price Industries.
    - g. Titus.
    - h. Tuttle & Bailey.
  - 2. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
  - 3. Finish: Baked enamel, white.
  - 4. Face Blade Arrangement: Horizontal spaced 1/2 inch apart.
  - 5. Core Construction: Removable.
  - 6. Rear-Blade Arrangement: Horizontal, spaced 1/2 inch centers for return and exhaust and 3/4 inch centers for supply, single set at 45 degrees for return or exhaust and double deflection adjustable for supply. Reinforced corners, mitered.
  - 7. Frame: 1 inch.
  - 8. Mounting Frame: Provide separable frames in drywall, plaster, or masonry construction as noted on the architectural drawings.
  - 9. Mounting: Countersunk screw.
  - 10. Accessories:
    - a. Filter.
- C. Fixed Face Grille
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anemostat Products; a Mestek company.
    - b. Carnes Company.
    - c. Krueger.
    - d. Nailor Industries Inc.
    - e. Price Industries.
    - f. Titus.
    - g. Tuttle & Bailey.
  - 2. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
  - 3. Finish: Baked enamel, white

4. Face Blade Arrangement: Horizontal, spaced 1/2 inch centers for return and exhaust and 3/4 inch centers for supply, single set at 45 degrees for return or exhaust and double deflection adjustable for supply. Reinforced corners, mitered.
  5. Face Arrangement: Perforated core.
  6. Core Construction: Removable.
  7. Frame: 1 inch
  8. Mounting Frame: Provide separable frames in drywall, plaster, or masonry construction as noted on the architectural drawings.
  9. Mounting: Countersunk screw.
  10. Accessory: Filter.
- D. Furnish and install turning vanes for connections to ducts.
- E. Where registers are located low near floor, they shall be heavy duty 14-gauge steel with fixed 45 degree blades on 1/2" centers. In damp areas, they shall be extruded aluminum.
- F. Where drawings indicate linear return grilles, they shall be linear extruded aluminum with 1/8" bars 3/4" long on 1/4" centers.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install registers and grilles level and plumb.
- B. Supports: Galvanized steel per SMACNA.
- C. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- D. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### **3.02 ADJUSTING**

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

## **SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS (6-25 Tons)**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

#### 1.04 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.05 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. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
  - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

#### 1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: One year(s) from date of Substantial Completion.

- c. For Labor: One year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Corporation; a unit of United Technologies Corp.
  2. Daikin
  3. Trane.
  4. YORK; a Johnson Controls company.

### 2.02 INDOOR UNITS (6 – 25 TONS)

- A. Vertical or Horizontal Evaporator-Fan Components:
1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
  2. Insulation: Faced, glass-fiber duct liner.
  3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  4. Single refrigeration circuit through 7 ½ ton, dual refrigeration circuit over 7 ½ ton, copper tube aluminum fin coil, factory pressure tested.
  5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
  6. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - b. Belt Driven Fan Motor. Provide dual fans on 12.5-25 ton air handlers.
    - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
  7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  8. Condensate Drain Pans:
    - a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
      - 2) Depth: A minimum of 2 inches deep.
    - b. Single-wall, galvanized steel sheet.
    - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on [one end] [both ends] of pan.
      - 1) Minimum Connection Size: NPS 2-inch.
    - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.



- e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- 9. Air Filtration Section:
  - a. General Requirements for Air Filtration Section:
    - 1) Comply with NFPA 90A.
    - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
    - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
  - b. Disposable Panel Filters:
    - 1) Factory fabricated, viscous-coated, flat-panel type.
    - 2) Thickness: 2 inches.
    - 3) Merv according to ASHRAE 52.2: 8,13.
    - 4) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
    - 5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.
    - 6) Filter Frame shall be fully gasketed.

### 2.03 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."
- B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- C. Automatic-reset timer to prevent rapid cycling of compressor.
- D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- E. Vibration isolation.
- F. Variable Frequency Drive and rated motor.

## PART 3 - PART 3 – EXECUTION

### 3.01 INSTALLATION

- A. Install units' level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment base –minimum 4 inch thick pad set on 6 inches of crushed stone.
- D. Equipment Mounting:
  - 1. Install ground-mounted, air handler on cast-in-place concrete equipment base(s).
  - 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- F. Coordinate the electrical requirements of the unit with the electrical contractor prior to ordering or installing the equipment.
- G. Furnish and install all controls and control wiring. Wiring shall be in accordance with the NEC. Control wiring above the roof shall be in galvanized steel conduit with watertight fittings.
- H. Installations shall be in accordance with the instructions of the manufacturer and meet all requirements.
- I. Protect and be responsible for equipment until accepted in place by the owner.
- J. Provide condensate drain and discharge to a suitable discharge point which shall be acceptable to the owner and A/E.
- K. All filters shall be new at time of acceptance by the owner.

### 3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

### 3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

### 3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to train owner's maintenance personnel to adjust, operate, and maintain units.
- B.

END OF SECTION

## **SECTION 23 81 27 - SPLIT-SYSTEM HEAT PUMP**

### **PART 1 - GENERAL**

#### 1.01 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

#### 1.04 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.05 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. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
  - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

#### 1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.

- b. For Parts: One year(s) from date of Substantial Completion.
- c. For Labor: One year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Carrier Corporation.
  - 2. Daikin
  - 3. Lennox Industries, Inc.
  - 4. Trane.
  - 5. YORK; a Johnson Controls company.

### 2.02 INDOOR UNITS (5 TONS OR LESS)

- A. Concealed Evaporator-Fan Components:
  - 1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
  - 2. Insulation: Faced, glass-fiber duct liner.
  - 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  - 4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
  - 5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
  - 6. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
  - 7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  - 8. Filters: Permanent, cleanable.
  - 9. Condensate Drain Pans:
    - a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      - 1) Length: Extend drain pan downstream from leaving face to comply

- with ASHRAE 62.1.
  - 2) Depth: A minimum of 2 inches deep.
  - b. Single-wall, galvanized-steel sheet.
  - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
    - 1) Minimum Connection Size: NPS 1.5-inch
  - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
  - e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- 10. Condensate overflow switch
  - 11. Low leakage Cabinet (Qleak) less than 2%.

## 2.03 INDOOR UNITS (7.5 TONS OR MORE)

### A. Concealed Evaporator-Fan Components:

- 1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
- 2. Insulation: Faced, glass-fiber duct liner.
- 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
- 4. Single refrigeration circuit through 7 ½ ton, dual refrigeration circuit over 7 ½ ton, copper tube aluminum fin coil, factory pressure tested.
- 5. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
- 6. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
- 7. Fan Motors:
  - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
  - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- 8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- 9. Filters: Permanent, cleanable 2" thick.
- 10. Condensate Drain Pans:
  - a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
    - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
    - 2) Depth: A minimum of 2 inches.
  - b. Single-wall, galvanized-steel sheet.
  - c. Drain Connection: Located at lowest point of pan and sized to prevent

overflow. Terminate with threaded nipple on one end of pan.

- 1) Minimum Connection Size: NPS 1.5-inch
- d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
- e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- f. Condensate overflow switch

## 2.04 OUTDOOR UNITS -5 TONS OR LESS

### A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - a. Compressor Type: Scroll.
  - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
  - c. Refrigerant Charge: R-410A.
  - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit

## 2.05 OUTDOOR UNITS - OVER 5 TONS

### A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - a. Compressor Type: Scroll.
  - b. Dual refrigeration circuit, copper tube aluminum fin coil, factory pressure tested.
  - c. Refrigerant Charge: R-410A.
  - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.

6. Low Ambient Kit
7. Hail Guards

## 2.06 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Section 230933 Automatic Temperature Control or 230933 Building Automation System
- B. Solid-State Thermostat: Wall-mounted programmable, microprocessor-based unit with automatic switching from heating to cooling, preferential rate control, seven-day programmability with minimum of four temperature presets per day, vacation mode, and battery backup protection against power failure for program settings. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits For 5 Tons and Under: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Drain Hose: For condensate.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install units' level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment support curbs.
- D. Equipment Mounting:
  1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). The base shall be a minimum of 4" thick and set on 6"s of crushed stone.
  2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
  3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Coordinate the electrical requirements of the unit with the electrical contractor prior to ordering or installing the equipment.
- F. Furnish and install all controls and control wiring. Wiring shall be in accordance with the NEC. Control wiring above the roof shall be in galvanized steel conduit with watertight fittings.
- G. Installations shall be in accordance with the instructions of the manufacturer and meet all requirements.
- H. Protect and be responsible for equipment until accepted in place by the owner.
- I. Provide condensate drain and discharge to a suitable discharge point which shall be acceptable to the owner and A/E.
- J. Contractor shall interlock the air handling unit controls with the remote condensing unit and

electric resistance heaters. Contractor is to furnish and install an air proving switch or current sensor at the air handler's blower and be interlocked with the associated condensing unit and electric resistance heater controls to shut down if power to the blower is disconnected.

- K. All filters shall be new at time of acceptance by the owner.

### 3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

### 3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.
- E. Any equipment mars, blemishes, scratches, abrasions, or other surface imperfections shall be sanded, primed, and refinished to match adjacent surfaces.
- F. No equipment will be accepted by the owner which has rust, corrosion, or otherwise in progress.
- G. Equipment shall not be used for temporary heat unless separately negotiated with the owner.
- H. All bare ferrous metal shall be painted prior to acceptance.

### 3.04 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION



## **SECTION 23 81 28 - DUCTLESS SPLIT SYSTEM**

### **PART 1 - GENERAL**

#### 1.01 REFERENCE

- A. Refer to Section 23 05 00 for requirements which are applicable to this section.

#### 1.02 WORK INCLUDED

- A. Provide all labor, material, equipment, and supervision necessary to furnish, install, and place into operation ductless split systems as specified herein.
- B. Power wiring will be provided under the Electrical portion of the work.
- C. Control wiring shall be furnished under this portion of the work.
- D. Furnish ductless split system heat pumps or air conditioning units of the quantity, size and capacity shown on the equipment schedules.
- E. System shall be a complete factory package consisting of compressor, evaporator coil, fan and motor, condenser coil fan and motor and complete refrigeration and heat pump temperature controls, and interconnecting wiring and refrigerant piping.
- F. Unit shall be rated in accordance with latest version ARI Standard 380 and shall be U.L. listed.

#### 1.03 SUBMITTALS

- A. Submit shop drawings of all equipment.
- B. Submit manufacturers' data sheets of capacity.
- C. Submit wiring diagrams of control system.
- D. Submit piping diagrams of refrigeration interconnection.

#### 1.04 QUALITY ASSURANCE

- A. Verify that all equipment is installed in accordance with the manufacturer's warranty requirements.

### **PART 2 - PRODUCTS**

#### 2.01 INDOOR UNIT

- A. The unit shall have a self-diagnostic function, 3-minute time delay mechanism.
- B. Factory pre-charge of R410A adequate for 33 feet of total length.
- C. The indoor units shall have a white, "flat screen" finish.
- D. The cabinet shall be supplied with a mounting plate to be installed onto a wall for securely mounting the cabinet.

- E. 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 wire remote controller.
- F. The evaporator fan shall be an assembly consisting of a direct-driven fan by a single motor. The fan shall be statically and dynamically balance and operate on a motor with permanent lubricated bearings.
- G. The return air filter provided will be a removable and washable filter.
- H. The evaporator coil shall be a nonferrous, aluminum fin on copper tube heat exchanger with factory pressure tested.

## 2.02 OUTDOOR UNIT

- A. The outdoor unit shall be specifically matched to the corresponding indoor unit size. The outdoor unit shall be complete factory assembled and pre-wired with all necessary electronic and refrigerant controls.
- B. The cabinet shall be Ivory White with a finished powder coated backed enamel paint.
- C. The fan shall be a direct drive, propeller type fan.
- D. The motor shall be inverter drive, permanently lubricated type bearings, inherent.
- E. The fan shall be capable of operating in “silent operation” which lowers the outdoor fan speed in either cool, heat or auto modes.
- F. A fan guard is provided on the outdoor unit to prevent contact with fan operation.
- G. The outdoor coil shall be nonferrous construction with corrugated fin tube.
- H. The compressor shall be a rotary swing inverter-driven compressor.
- I. The outdoor unit shall have an accumulator, four-way reversing valve.
- J. The compressor shall have an internal thermal overload.
- K. The outdoor unit can operate with a maximum vertical height difference of 49 feet and overall maximum length of 66 feet without any oil traps, liquid or suction line changes.

## 2.03 REMOTE CONTROLLER

- A. Microprocessor technology with remote controller with LCD display.
- B. Operation Mode Setting (Heat, Auto, Cool/Dry).
- C. Temperature setting (in units of two degrees Fahrenheit)
- D. Self-Diagnostic Display.
- E. Room Temperature Display.
- F. Twenty-Four Hour On/Off Timer.
- G. Fan Speed Indicator.
- H. Auto/Speed Vane Operation
- I. Memory (for storing operation functions)
- J. Low Ambient Operation
- K. Whisper-Quiet Operation
- L. EMS Gateway Available to Management System via RS-232 Cable.

## 2.04 MANUFACTURERS

- A. Manufacturer: Daikin or equal by Mitsubishi, Sanyo, EMI.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL**

- A. Install units in accordance with manufacturer's instructions.
- B. Mount compressors on Neoprene pads on roof curbs.
- C. Mount indoor unit on concealed blocking for additional support.
- D. Install pre-charged refrigerant lines through manufactured roof curbs by Pate or equal. Maintain watertight integrity of penetration.

END OF SECTION

## SECTION 23 82 16 - COILS FOR SEPARATE DUCT MOUNT

### PART 1 - GENERAL

#### 1.01 REFERENCE

- A. Refer to section 15000 for requirements which are applicable to this section.
- B. All equipment shall be installed in accordance with the requirements of SMACNA, ASHRAE, ARI, and meet their standards of performance. Equipment shall be UL listed.

#### 1.02 WORK INCLUDED

- A. Provide all labor, material, equipment, and supervision necessary to install and place into operation the equipment and systems described herein.
- B. Provide spiral fin type coils for mounting in ductwork or for building up free standing coil banks as indicated on the drawings.
- C. All coils shall be certified in accordance with ARI Standard 410. All coils shall be tested at 350 psig air pressure while submerged in water. Equipment schedules and specifications are based on

\* Trane Type \*\* Coils

#### 1.03 SUBMITTALS

- A. Submit shop drawings of all items described in this section.
- B. Submit manufacturer's data sheets.

#### 1.04 QUALITY ASSURANCE

- A. Verify that all equipment is installed in accordance with the manufacturer's warranty requirements.
- B. Install systems and equipment in accordance with the manufacturer's instructions.
- C. Provide adequate supervision of labor force to see that installations are correct.

### PART 2 - PRODUCTS

#### 2.01 CHILLED WATER COILS

\* Carrier

- A. Shall have aluminum fins hermetically wound under tension to 5/8" OD copper tubes. Tubes

shall be brazed to steel headers. Headers shall have threaded pipe connections. Working pressure shall be 300 psig at 200 degrees F.

\* Trane

- B. Shall have plate type aluminum fins with full fin collars bounded to 5/8" on copper tubes. Tubes shall be expanded into full fin collars and expanded into cast iron headers. Headers shall have threaded pipe connections. Working pressure shall be 200 psig at 325 deg. F.
- C. Coils are to be installed level and be completely drainable with non-trapping circuits.
- D. Tube supports shall be provided so that maximum unsupported tube span is 40".
- E. Casings to be flanged and drilled galvanized steel.
- F. Coils to be installed in accordance with manufacturer's instructions to ensure counter flow between air and water.

## 2.02 HOT WATER OR STEAM COILS

- A. Shall be of same construction as chilled water coils specified above. Connections of small duct mounted coils shall be plain end copper tubes with no headers. Larger coils shall have steel headers with threaded connections.
- B. Working pressure shall be 175 psig at 400 degrees F or 300 psig at 300 degrees F.

## 2.03 STEAM DISTRIBUTING (NON-FREEZE) COILS

- A. Shall be of same construction as chilled water coils specified above except tubes shall be 1" OD outer and 5/8" OD inner copper for finned tube length of 60" or greater, and 5/8" OD outer and 3/8" inner for finned tube length less than 60".
- B. Working pressure shall be 175 psig at 400 degrees F.

## 2.04 DX COILS

- A. Shall be constructed with aluminum plate fins mechanically bonded to nonferrous tubing with all joints brazed.
- B. The enclosure shall be insulated and finished with baked enamel or equivalent corrosion-resistant surface.
- C. The casing shall be galvanized steel. The casing shall be flanged and allow for space to install a field supplied thermostatic expansion valve.
- D. Copper headers.

## 2.05 ACCESSORIES

- A. Non-ferrous headers
- B. Victaulic header connections
- C. Cleanable return bends
- D. Copper fins
- E. Solder coating copper fins
- F. Increased tube wall thickness
- G. Special casings
- H. Non-standard lengths and widths

### **PART 3 - EXECUTION**

#### **3.01 GENERAL**

- A. Suspend coil from building structure independently from piping.
- B. Provide pipe union and shut off valves at piping connections to the coil.
- C. Refer to the manufacturer's instructions for proper installation.

#### **3.02 STEAM COILS**

- A. Drip steam supply main through a steam trap in the return main downstream from the coil.
- B. Locate steam trap so that the outlet is a minimum of 12" below the coil connection. Provide a steam trap for each coil.
- C. Traps should have a minimum capacity of 3 times the coil condensate rate.
- D. Maintain a minimum of 5 psi steam pressure on the coil using face and bypass damper control when handling subfreezing air.

#### **3.03 HOT WATER COILS**

- A. Provide freeze up protection if coils are to be shutoff during subfreezing conditions.
- B. Follow the manufacturer's instructions for draining and protecting from subfreezing temperatures.

#### **3.04 CHILLED WATER COILS**

- A. Connect the entering water supply to the leaving air side of the coil.
- B. Provide drain pan, traps and piping suitable for condensate removal.

#### **3.05 DX COILS**

- A. Connect suction and liquid refrigerant piping to the coil.
- B. Provide drain pan, trap and condensate piping to acceptable discharge point.

END OF SECTION

## **SECTION 23 82 30 - CONVECTORS, EXTENDED FIN RADIATION, UNIT HEATERS**

### **PART 1 - GENERAL**

#### 1.01 REFERENCE

- A. Refer to section 23 05 00 for requirements which are applicable to this section.

#### 1.02 WORK INCLUDED

- A. Provide all labor, material, equipment, and supervision necessary to install and place into service the convectors, radiators, and unit heaters described in these specifications.

#### 1.03 SUBMITTALS

- A. Submit shop drawings of all equipment.
- B. Submit manufacturers' data sheets of equipment capacity.

#### 1.04 QUALITY ASSURANCE

- A. Verify that all equipment is installed in accordance with the manufacturer's warranty requirements.
- B. Install systems and equipment in accordance with the IBC 2003 Code and the National Electrical Code.

### **PART 2 - PRODUCTS**

#### 2.01 BASEBOARD EXTENDED FIN RADIATION

- A. Size and capacity as indicated on drawings.
- B. 3/4" copper tube 2 1/8" X 2 5/16 .007" aluminum elements, 51 FPF.
- C. Enclosure with baked enamel finish, damper assembly, front panel, element guide.
- D. Complete with inside and outside corners, front splices, end caps and end pieces.
- E. 600 BTU per foot at 180 deg. 4 GPM.
- F. Weil McLain Model 75WLT-3 ThermaTrim Baseboard.

#### 2.02 CONVECTORS

- A. Furnish and install convectors of the size and capacity indicated on the drawings. Convectors shall be recessed, semi-recessed, wall, or floor mounted as indicated. Cabinets shall be 16-gauge steel front and top with 20-gauge steel enclosures. Cabinets shall be phosphatized and painted inside and out with one coat of combination light beige prime finish baked on. A baked enamel finish in a color selected by the Architect from manufacturer's color chart shall be provided.
- B. Recessed and semi-recessed models shall be provided with a matching steel wall frame which shall overlap the opening edges and remain permanently in place. The cabinet front shall fit into a gasketed recess to form a flush front cabinet line on recessed models. Front panels shall be fastened with tamper proof Allen head machine screws.
- C. Access panels shall be provided for access to control and shut off valves.
- D. Convectors fed from below shall be provided with a brass air chamber vent assembly.
- E. Heating elements shall be 1/2 inch round seamless copper tubes with aluminum fins and 1-inch seamless copper headers. Tubes shall be mechanically expanded into fin spacing collars and silver solder brazed to the headers. Header tapping's shall be 3/4-inch FPT. Heating elements shall be tested at 320 PSI hydrostatic pressure.
- F. Convectors shall have inlet and outlet grilles die formed with directional louvers.

#### 2.03 EXTENDED FIN RADIATION

- A. Furnish and install extended fin radiation of the size and capacity indicated on the drawings.
- B. Units shall be wall mounted with 20-gauge steel back plate extending the full height of the enclosure.
- C. Elements shall be copper tube mechanically expanded into .018" thick aluminum fins.
- D. Enclosures shall be 16-gauge steel.
- E. Provide end caps, outside corners, inside corners, and end enclosure with access door.
- F. Slope top units shall have expanded steel discharge grille.
- G. Units shall have extruded aluminum top grilles.
- H. Manufacturers; Airtherm, Vulcan, Slant-Fin, Trane, Standard Fin Pipe.

#### 2.04 UNIT HEATERS - CABINET TYPE

- A. Wall mounted, recessed, or semi-recessed as indicated on the drawings.
- B. Seamless copper tube elements, filters and filter rack, direct drive fans, double extended shaft. Fan and motor mounted on a single motor board, die formed fan housing.
- C. Front panels removable, acoustically insulated, access door to motor, end piping compartment, 16-gauge cabinets, inlet grille in base, and 2-way adjustable discharge grille.
- D. Manufacturers; Airtherm, Vulcan, Slant-Fin, Trane.

#### 2.05 UNIT HEATERS - PROPELLER TYPE

- A. Wall mounted or ceiling mounted propeller type as indicated on the drawings.
- B. Seamless copper tube elements with plate fins, direct drive fan, permanently lubricated split capacitor motor.
- C. Manufacturers; Airtherm, Vulcan, Slant-Fin, Trane.



- D. Casings phosphatized and painted with baked enamel.
- E. Horizontal and vertical adjustable louvers.

#### 2.06 CAST IRON EXTENDED FIN RADIATION

- A. Wall mounted cast iron sections with internal water passages and rear fins.
- B. Complete with valve enclosures, wall extensions, inside and outside corners, and accessories as necessary for a complete installation.
- C. Weil McLain Snug Baseboard.

#### 2.07 FLOOR RECESSED EXTENDED FIN.

- A. Floor recess formed by others.
- B. Install heating element, bracket, baffles and supports along with all necessary pipe, valves and fittings.
- C. Continuous baffle 20-gauge steel.
- D. 16" x 1 1/2" brackets at maximum 4'-0" on center.
- E. Capacity as scheduled on the drawings.
- F. Furnish and install top extended aluminum bar grille to span opening. Provide steel angle iron recessed frame.
- G. Paint brackets, baffles, elements and piping flat black. Paint inside of trench flat black.
- H. Manufacturer: Vulcan, Sterling, or approved equal.

#### 2.08 PERIMETER RADIATION - FIELD BUILT ENCLOSURES

- A. Furnish and install wall mounted extended fin radiation complete with valves, fittings, brackets and supports.
- B. Element and tube size as indicated on the drawings.
- C. Copper tube, aluminum fin elements tested at 300 psi.
- D. Extruded aluminum discharge grille with .162" bars on 1/2" centers. 67% free area cross bars on 6" centers. Vulcan type VA or equal.
- E. Enclosure fabricated as detailed on the architectural drawings.

#### 2.09 PEDESTAL RADIATION

- A. Single width units shall be 6 1/4" wide, double width shall be 11 3/16" wide by 5 1/4" high with 3 7/8" pedestals, 18-gauge front and back panels.
- B. Units shall have extruded top grille.
- C. Units shall have copper tube, aluminum fin coils of the size and capacity indicated on the drawing.
- D. Units shall be available in a choice of 8 baked enamel colors.
- E. Units shall be Trane Type E3A.

### **PART 3 - EXECUTION**

#### **3.01 CONVECTORS, RADIATION, AND UNIT HEATERS**

- A. Provide rough opening information to the General Contractor to allow for proper wall openings during construction.
- B. Field measure each existing recessed opening for the actual dimension of the required convector. Provide a shop drawing indicating the room number of each space, the opening size, and the type of convector to be provided in the recess. Indicate as to whether the convector is to be recessed, semi-recessed, wall, or floor mounted, and the heating capacity and conditions of performance.
- C. Provide a color chart for selection of color by the Architect.
- D. Install the convector or unit heater with 1-inch rigid fiberglass insulation behind and around the convector where placed in outside walls.
- E. Piping to all elements shall be provided with unions, an automatic control valve on the return side, flow measuring device set to the GPM quantity indicated in the schedule and shut off valves for servicing.
- F. Provide a mockup of the first unit for review and acceptance by the A/E prior to installation of remaining units. This shall also be reviewed by the owner's representatives prior to further installations.

END OF SECTION

## **SECTION 23 83 33 - ELECTRIC HEATERS AND HEAT TRACING**

### **PART 1 - GENERAL**

#### 1.01 REFERENCE

- A. Refer to Section 23 05 00 for requirements which are applicable to this section.
- B. Refer to International, NFPA, NEC, and UL requirements for standards relating to these specifications.

#### 1.02 WORK INCLUDED

- A. Provide labor, material, equipment, and supervision necessary to install and place into operation all of the equipment specified in this section.

#### 1.03 SUBMITTALS

- A. Submit manufacturers shop drawings and catalog data sheets of all items in this section.

#### 1.04 QUALITY ASSURANCE

- A. Verify that all equipment is installed in accordance with the manufacturer's instructions.
- B. Provide benchmark construction for review of the owner and architect prior to installation of remaining units. Benchmark unit shall, after review and approval, become the standard against which all other units will be matched.

### **PART 2 - PRODUCTS**

#### 2.01 ELECTRIC BASEBOARD

- A. U.L. Listed, 250 watt per foot density, full length curtain guard, continuous rug guard, 18 gauge steel front cover.
- B. Automatic linear cutout over entire length of heat element.
- C. Continuous raceway, either end connection junction box, aluminum finned metal sheath heating element.
- D. Remote wall mounted thermostat wired by this contractor.
- E. Inside and outside corners as required for installation.
- F. Manufactured by Berko, Markel, QMark or preapproved equal

#### 2.02 WALL MOUNTED ELECTRIC HEATERS

- A. Unit to be UL listed, 16-gauge front panel, baked enamel finish, fully enclosed fan motor permanently lubricated, with integral thermostat.
- B. Units to be by QMark, Markel, Berko or preapproved equal

#### 2.03 CABINET UNIT HEATERS

- A. Unit to be UL listed, cold rolled steel enclosure with baked enamel finish, direct drive blower and motor, 2 speed, overheat protection, integral thermostat, and cleanable filters.
- B. Manufactured by QMark, Markel, Berko or preapproved equal

#### 2.04 WALL MOUNTED AND PEDESTAL HEATERS

- A. Unit to be U.L. listed and of the size and capacity indicated on the drawings.
- B. Units shall have top extruded aluminum grille and two finished sides. Heating elements shall be cal-rod type element installed within aluminum tubes mechanically expanded into aluminum fins and suspended between junction boxes, factory installed raceway, and baked enamel finish in color selected by the Architect.
- C. Manufacturers; QMark, Markel, Berko or preapproved substitute.

#### 2.05 FAN FORCED WALL HEATERS

- A. Unit to be U. L. listed and of the size and capacity indicated on the drawings.
- B. Overheat protection, integral thermostat, nickel chromium alloy heating elements, permanently lubricated motor, 3 position switch.
- C. Finish to be selected by Architect.
- D. Manufacturers: QMark, Markel, Berko, or preapproved substitute.

#### 2.06 ELECTRIC UNIT HEATERS - SUSPENDED

- A. Built in or remote thermostat as indicated on the drawings.
- B. Mounting brackets.
- C. Totally enclosed, permanently lubricated motor.
- D. Element steel finned sheath, zinc plated.
- E. Auto reset cutout, UL listed.
- F. Manufacturer: Markel, Berko, QMark or preapproved equal

#### 2.07 ELECTRIC PIPELINE HEAT TRACING

- A. Furnish and install where required by specification or indicated on the drawings, a complete system of electrical heat tracing. The trace shall be a mineral insulated cable of copper or copper alloy sheathed heating element in dielectric refractory material. Piping is to be appropriately marked as required by NEC 427.13.
- B. Furnish cable in lengths and wattages required to maintain the pipe above 40 degrees at an outside temperature of 10 degrees. All piping shall be insulated after installation of the heating element. Use 3 watts per ft. for piping up to and including 1 inch in diameter, 4 watts per ft for piping to and including 2 inch, 5 watts per ft. for piping to and including 3 inch, 7 watts per ft. for 4 inch, and 10 watts per ft. for 6 inches. Allow an additional 15 % for valves

and fittings.

- C. Cable shall be Type MI as manufactured by Chromalox, Raychem or approved substitute and be complete with adjustable thermostat for each location.

#### 2.08 RADIANT CEILING PANELS

- A. Recessed, T-bar, or surface mounted as required to suit particular ceiling type.
- B. Pre-wired - 36" flexible cable connection to junction box.
- C. 120 volt 277 or 240 volt wiring.
- D. Continuous heating element of electric resistance graphite imbedded between two layers of insulation. Outer shell of steel with baked enamel finish. 1" deep.
- E. White finish or silk-screened pattern to match adjacent surfaces.
- F. UL listed.
- G. Furnish and install with thermostat for each space.
- H. Manufacturers: Markel, Berko, Aztec or preapproved equal

### **PART 3 - EXECUTION**

#### 3.01 INSTALLATION

- A. Coordinate locations and rough-in requirements with other trades prior to installation.
- B. Coordinate electrical requirements with the electrical contractor prior to purchasing equipment. Verify voltages and amperages for feeders.
- C. Provide for benchmark construction as described above.
- D. Adjust, place in service, and provide instructions, guarantees, and maintenance manuals to the owner.
- E. Install electrical heat tracing cable in conformance with the manufacturer's recommendations. Test heating circuits before insulating. Arrange with electrical contractor for electrical power circuits.

END OF SECTION

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## DIVISION 26 - ELECTRICAL

### SECTION 26 00 00 - STANDARD CONDITIONS FOR ELECTRICAL WORK

#### PART 1 - GENERAL

##### 1.01 REGULATIONS, CODES, STANDARDS

- A. Reference Codes, applicable sections of the following codes and standards shall be considered as binding to the work of this project:
- |       |                                                   |
|-------|---------------------------------------------------|
| NEMA  | National Electrical Manufacturers' Association    |
| NEC   | National Electrical Code (NFPA 70) - 2017 Edition |
| NECA  | National Electrical Contractors' Association      |
| NEIS  | National Electrical Installation Standards        |
| EGSA  | Electrical Generating Systems Association         |
| IBC   | International Building Code                       |
| NFPA  | National Fire Protection Association              |
| IEEE  | Institute of Electrical and Electronics Engineers |
| UL    | Underwriter's Laboratories, Inc.                  |
| IES   | Illuminating Engineering Society                  |
| OSHA  | Occupational Safety and Health Administration     |
| ANSI  | American National Standards Institute             |
| ASTM  | American Society for Testing and Materials        |
| FM    | Factory Mutual                                    |
| IRI   | Industrial Risk Insurers                          |
| ISO   | Insuring Services Office                          |
| IPCEA | Insulated Power Cable Engineers Assoc.            |
| ADA   | Americans with Disability Act                     |
| NETA  | International Electrical Testing Association      |
- B. All local codes are to be incorporated.
- C. The latest adopted codes and latest editions of standards shall be the basis of conformance.
- D. Obtain and pay for all permits and inspections, and any associated charges.
- E. Inspection Agency Certificate of Inspection to be provided at completion of the work. Inspection by Middle Department Inspection Agency, Inc., or other local inspection agency.
- F. Drawings, Contract, General Conditions and Supplementary Conditions form a part of this section, by reference thereto and shall have the same force and effect as if printed herewith in full. Failure to review these sections shall not relieve the Contractor of his responsibility to fully comply with the terms therein.
- G. Where the contract documents are more stringent but not in conflict with the applicable codes, the more stringent requirements shall be followed.

##### 1.02 SUBMITTALS

- A. The procedure for submissions of shop drawings shall be as specified in Division 1, or as a minimum, as indicated below.
- B. Furnish submissions of shop drawings and samples of materials and equipment as indicated

- in these sections, on the drawings, or as directed by the architect/ engineer. Submissions will be made in a timely fashion such that adequate time exists to review the drawings, or material, and arrive at the site in accordance with the project schedule.
- C. Submissions will not be accepted with work defined as "By Others". Identify contractor by name and with his approval so indicated. Submissions are required prior to purchasing, fabrication, or installation of any material or equipment. Submissions shall be reviewed and certified by the submitting contractor that they are in accordance with the project documents.
  - D. When requested by the engineer, shop drawings shall be required to be submitted to designated agencies for review and approval prior to submission to the engineer.
  - E. Contractor shall arrange and pay for all tests and inspections specified herein or required by above agencies and furnish required certificate of inspection to owner.
  - F. Contractor shall provide performance test data and wiring diagrams of all electrical equipment.
  - G. Submissions shall include warranties by the manufacturer for equipment being provided. Submissions for commonly related items such as fixtures, trim, carriers, shall be combined in a single brochure clearly identifying all items being furnished.
  - H. Shop drawings and submittals shall be checked and stamped by the contractor before submitting. They shall conform to measurements made at the site, the contract requirements, and shall be coordinated with all other trades.
  - I. Specific models in catalog sheets must be identified as well as all options, voltages, phases, etc. identified to be clear as to what is being provided.
  - J. Contractor and manufacturers shall be responsible for all physical characteristics of the equipment and field verify with final locations, coordinate with floor plans, confirm service access, clearances, confirm equipment arrangements, electrical disconnect clearances, and pathways/ travel/ access to the final equipment installation locations. Submission of equipment shop drawing will be deemed evidence of compliance with this requirement. If no shop drawing is submitted, contractor shall be fully responsible for a complete installation and assumes all related costs that affects the contractor and other trades.
  - K. To aid in the preparation of submittals or shop drawings, the engineer can provide the electronic files for use by the contractor. The electronic files will be provided upon execution of the engineer's electronic file release contract prepared specifically for this project. The electronic files will be released in the format used by the architect and engineer to design the project. If this file format is not compatible with the contractor's needs, additional charges for providing the changes to the requested file format may be necessary at \$150.00 per hour billable to the contractor.

### 1.03 SUBSTITUTIONS

- A. Substitution of other than specified manufacturers shall not be allowed after bid date.
- B. Prior approval is required for other manufacturers. If the contractor wishes for alternate materials or equipment to be considered, he must submit information at least ten days prior to the bid date. If acceptable, an addendum will be issued allowing the contractor to utilize the approved alternate.
- C. Samples shall be provided when directed by the architect or engineer.
- D. If the contractor submits alternate equipment, manufacturers, systems, methods, or materials not specifically identified in the specifications, additional review and investigation time may be required by the engineer. If the engineer determines additional review time is required because of the substitution, then this will be a billable service provided by the engineer at the rate of \$150.00 per hour. Also billable will be any redesign time and revisions to drawings



should they be necessary for incorporation into the work. Services will be billable to the contractor making such substitutions and will be payable prior to approval, or rejection.

- E. If the contractor elects to submit alternate equipment, manufacturers, systems, methods, or materials, not specifically identified in the drawings and specifications, it is the contractor's responsibility to coordinate the work with other trades and pay for any associated costs with the substitution or change.
- F. Contractor and manufacturers shall be responsible for all physical characteristics of the equipment and field verify with final locations, coordinate with floor plans, confirm service access, clearances, confirm equipment arrangements, electrical disconnect clearances, and pathways/travel/access to the final equipment installation locations. Submission of equipment shop drawing will be deemed evidence of compliance with this requirement. If no shop drawing is submitted, contractor shall be fully responsible for a complete installation and assumes all related costs that affects the contractor and other trades.

#### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and equipment in manufacturer's original cartons or on skids.
- B. Store materials in dry enclosure out of way of work progress.
- C. Protect equipment, fixtures, and lenses after placement.

#### 1.05 REFERENCE

- A. Requirements established within the portions of this Project Manual titled Division 1, General Requirements are collectively applicable to the work of this section.
- B. Instructions to Bidders, Special Conditions and Addenda as issued are part of this specification.
- C. Electrical drawings along with all other project drawings represent the work of this Division.
- D. Drawings, Contract, General Conditions and Supplementary Conditions form a part of this section, by reference thereto and shall have the same force and effect as if printed herewith in full. Failure to review these sections shall not relieve the Contractor of his responsibility to fully comply with the terms therein.

#### 1.06 WORK SUMMARY

- A. Provide labor, materials, equipment, and supervision necessary to install complete, operating electrical systems as indicated on the drawings and specified herein, including all work at the site and within the proposed construction areas to accomplish the require work.
- B. Contractor shall provide all demolition necessary to remove, replace, repair, install new or modify existing work whether it be walls, floors, ceilings, structure, mechanical or electrical required to install his work. Contractor shall replace all work to leave in a finished condition. Pipe, conduit, ductwork, and wiring shall be cut back behind wall surfaces above ceilings and below floor levels so that a patch can be placed over the opening.
- C. Demolition:
  - 1. Contractor shall disconnect and remove panels, luminaires, conduit, wiring, supports, fasteners, starters, fire alarm devices and wiring, telephone equipment and wiring, battery packs, controls, outlets, and devices within the renovation area and where indicated on plans.
  - 2. Electrical contractor shall verify all existing conditions prior to commencing work.
  - 3. Remove branch circuits back to the power source or the nearest device to remain active. Restore all circuits interrupted by the demolition work to maintain circuit continuity.

4. Label all overcurrent protection devices made “spare” due to demolition. Update all panelboard directories impacted by the demolition.
  5. Relocate existing branch circuits which interfere with new construction whether specifically identified or not. Refer to architectural drawings for new walls, structure, millwork, etc. which may require existing conduit, wire, etc. to be relocated.
  6. It is the intent that power remain active in adjacent areas during the construction. Contractor is to modify existing wiring arrangement to comply.
  7. All equipment and appurtenances removal are to be disposed of properly. Refer to local, state, and federal requirements.
- D. All work shown on the drawings and not expressly mentioned in the specifications and all work specified but not shown on the drawings, but necessary for the proper execution of same shall be performed by the contractor. It is not the intent of the drawings and specifications to describe every feature and detail of the work.
- E. No additions to the contract amount will be approved for any materials, equipment, or labor to perform additional work unless it can be clearly shown to be beyond the scope and intent of the drawings and specifications.
- F. Provide roof penetrations for electrical work and all associated roof work.
- G. Provide addressable fire alarm system with battery back-up, horn/ strobes, pull stations, detectors, strobes, duct detectors, remote annunciator, elevator controls for recall and shutdown of power, telephone auto dialer, firefighter phones, and all associated controls and appurtenances.
- H. Provide exit and emergency luminaires throughout with emergency power supply in addition to normal power.
- I. Provide power to HVAC and plumbing equipment as necessary to have complete, operating systems.
- J. Provide luminaires throughout, with exterior luminaires at all egress doors.
- K. Provide telephone conduit system. Provide (2) CAT 3 plenum rated telephone cables from the telephone demarcation point to the fire alarm control panel for the auto dialer.
- L. Provide grounding in accordance with the NEC.
- M. Provide addressable security system with battery back-up, intrusion detection sensors, signal equipment, system controls, alarm displays, alarm indicating devices, telephone auto dialer, and manual keypads to change system status, wiring methods, and appurtenances.
- N. Provide code required signage (i.e., NEC 110.34, NEC 700.8, and 695.4 B3).
- O. Refer to Commissioning of Systems Specification for additional scope of work.

#### 1.07 SITE INSPECTION

- A. Visit site, inspect, and become aware of all conditions which may affect the work. Investigate utilities, protection requirements for adjacent facilities, storage locations, and access to the construction area.
- B. Submission of a bid will be deemed evidence of being in compliance with this requirement. Contractor may not request additional costs for existing conditions which were evident from inspection of the site.
- C. Before ordering materials or commencing with any work, the contractor shall verify all measurements at the building. Coordination of equipment, materials, spaces, and dimensions are the responsibility of the contractor.

#### 1.08 UTILITY CONNECTION AND CHARGES

- A. The contractor shall be responsible for coordination of the work with the Electric Utility Company.

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Kimmel Bogrette Architecture  
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Make all arrangements in a timely fashion for connection of the service.

- B. The Electrical Contractor shall be responsible for utility connection charges, meter charges, and other installation charges as may be applied by the local utility company.
- C. Contact the utility company during the bidding period for connection charges and include same with bid.
- D. Provide connections, terminations, handholes, manholes, pads, transformers, vaults, conduits, wiring, and all required materials and labor as may be required by the utility company to obtain service for the facility. Any costs for service work shall be included in the bid.

1.09 DRAWINGS AND SPECIFICATIONS

- A. Drawings and specifications are intended to be taken as a whole and each is to supplement the other. It is not intended that all work must be both shown on drawings and specified in the specifications.
- B. An item shown on the drawings and not indicated in the specifications is to be understood to be required for the project. An item specified and not shown on the drawings is to be understood to be required for the project.
- C. If there is a conflict between the drawings and specifications it is to be understood that the more strict or more expensive interpretation shall govern. Also, if a conflict exists between specification sections or between drawing plans and details, it is to be understood that the more strict or more expensive interpretation shall govern.
- D. The architect’s or engineer’s interpretation of the documents shall be binding upon the contractor. If a question arises, the contractor shall ask for an interpretation prior to bidding and an answer shall be issued as an addendum to all bidders.
- E. If a question arises after bidding the architect’s and/ or engineer’s interpretation shall govern.
- F. The drawings are generally diagrammatic and necessary field coordination and adjustment must be provided by the contractor prior to installation. Such deviations to the work to allow for coordination shall be kept to a minimum and any such deviations shall be at no extra cost.

1.10 MINIMUM INTEGRATED EQUIPMENT SHORT CIRCUIT RATING:

- A. Where the contract documents indicate secondary service from the utility Company (208/120V, 3 phase, or 480/277V, 3 phase) available short circuit currents including system motor contribution (amperes RMS symmetrical) at the line terminals of the UL service entrance labeled main distribution panelboard or switchboard, shall be in accordance with the following tabulation:

Service Minimum	Service Entrance	Panelboard Rating	Transformer Rating
kVA	%Z	208/ 120V	480/ 277V
75	1.5	14,500	10,000
112.5	1.5	22,000	10,000
125	1.5	29,000	13,000
225	1.5	43,000	19,000
300	1.5	58,000	25,000
500	1.5	96,000	42,000
750	5.5	42,200	18,000
1000	5.5	56,100	24,500
1500	5.5	85,000	37,000
2000	5.5		49,000

2500	5.5		51,000
3000	5.5		73,500

- B. The Integrated Equipment short circuit rating of the main distribution panel, or switchboard shall meet or exceed the tabulated minimum values. This shall be construed to mean that the equipment withstands capability (bus-bracing), and interrupting capacities of main and feeder devices, shall each meet or exceed the tabulated minimum values.
- C. Service transformer ratings shall be as indicated on the drawings. If said ratings are not indicated, the contractor shall contact the engineer and/ or utility company for clarification.
- D. The only deviations from this tabulation that are permissible shall be the results of a short circuit study (if and as specified in Section 26 05 73 Power System Studies), or documented data from the utility company.

#### 1.11 PROGRESS SCHEDULE

- A. Provide a project schedule which shall show start, sequence of each type of work, milestone schedule, and completion of each type of work, with overall completion date.

#### 1.12 COST SCHEDULE

- A. Provide a detailed cost breakdown indicating labor and material amounts for various types of work.
- B. AIA forms are required for this submission.

#### 1.13 OFFICE

- A. The contractor shall set up his job office (desk) where directed by the owner.

#### 1.14 STORAGE

- A. Material shall be stored only where directed by the owner.

#### 1.15 SANITARY

- A. The contractor will at his own expense, provide and maintain in a sanitary condition, a portable chemical toilet.
- B. Toilet will be located where directed by the owner.

### PART 2 - PRODUCTS

#### 2.01 GENERAL

- A. All materials and equipment shall be new and in present production of major manufacturers.
- B. All materials and equipment shall be in conformance with accepted trade standards as a minimum. Where specifications exceed any minimum standard, the specifications shall govern.
- C. Reference of equipment in the singular shall be deemed to apply to as many such items as may be

required to complete the work.

- D. The word “provide” means “furnish and install complete, tested, and adjusted as necessary with all accessories, wiring methods, switching, lenses, mounting hardware, cover plates, hangers and supports”.

## 2.02 FASTENERS AND SUPPORTS

- A. All work shall be securely fastened to building construction.
- B. Utilize toggle or machine bolts in hollow construction.
- C. Utilize machine screws for steel construction.
- D. Utilize expansion shields for masonry construction.
- E. Utilize lag bolts for wood construction.
- F. All fasteners shall be galvanized or plated with rustproof finish.
- G. Maximum load on fasteners shall be at a safety factor of 4:1 for a tested sample.

## 2.03 MOTOR STARTERS AND CONTACTORS

- A. Single-phase manual motor starters with overloads shall be provided under the electrical portion of the work for fractional horsepower motors up to ½ HP.
- B. Polyphase motor starters and motor starters above ½ HP shall be furnished under other portions of the work.
- C. The starters in A, or B above shall be installed under the electrical portion of the work.
- D. Polyphase starters shall be magnetic combination type, across-the-line, electrically operated, electrically held, three-pole assemblies, with arc-extinguishing characteristics, silver-to-silver renewable contacts, three-pole thermal bi-metallic, red “run” pilot light, individual phase protection, with overload heaters matched to motors installed and with four auxiliary contacts, Hand-Off-Auto switch, and control transformer.
- E. For single-phase motors above ½ HP provide magnetic combination, single-phase motor starters with overloads, non-fusible disconnect switch, red run pilot light, integral 120 volt control transformer with dual primary fusing, auxiliary contacts.
- F. Starters shall be as manufactured by G.E., Cutler Hammer, Siemens, Square D or Allen Bradley.
- G. Contactors shall be across-the-line, electrically operated, mechanically held three-pole assemblies for tungsten and ballast luminaire loads. Acceptable manufacturers: GE, Cutler Hammer, Siemens, Square D or Allen-Bradley.
- H. Manual motor starters without overloads in NEMA 1 enclosure equal to G. E. Type TC shall be used for the following load:
  1. 30 amperes or less, continuous.
  2. 1 HP or less at 120 volts
  3. 2 HP or less at 240 volts

## 2.04 MANUFACTURERS' NAMES

- A. Manufacturers' names are included herein to establish those suppliers who may provide products for this project subject to the requirements of the specifications. Although a manufacturer's name may appear as an acceptable supplier it is not understood that a standard product is acceptable. Products must also meet the technical, performance, and physical requirements of the project as well as being named in the specification. Any deviations from this must be acknowledged during the bid phase by the supplier, who shall be solely responsible for any and all costs associated with the application of their product(s) in the project.

- B. A design cannot be prepared which accommodates the installation of all suppliers and is not intended to do so. If certain modifications must be made to accommodate one particular supplier's equipment it shall be considered the contractor's responsibility to arrange for such accommodations and be financially responsible for same.

### **PART 3 - EXECUTION**

#### **3.01 WELDING**

- A. All electric power for arc welding shall be supplied by the contractor performing the work.

#### **3.02 VEHICLES**

- A. Vehicle access to the site will be as directed by the owner.

#### **3.03 RUBBISH DISPOSAL**

- A. Except for items or materials identified to be reused, salvaged, reinstalled, or otherwise indicated to remain property of the owner or tenant, demolished materials shall become the contractor's property and shall be removed, recycled, or disposed from the project site in an appropriate and legal manner.
- B. Burning of debris on the site shall not be permitted. All debris, refuse, and waste shall be removed from the premises at regular intervals. No accumulation shall be permitted.

#### **3.04 WORKMANSHIP**

- A. Maintain all public walks and access ways.
- B. Erect and maintain barricades, warning signs, and other protective means as may be directed by the owner for protection of all persons and property from injury or damage.
- C. Plug or cap open ends of piping systems and conduit.
- D. Stored materials shall be covered to prevent damage by inclement weather, sun, dust, or moisture.
- E. Protect all installed work until accepted in place by the owner. Protect luminaires.
- F. Do not install plates, covers, and other finished devices until masonry, tile, and painting operations are complete, or protect otherwise.
- G. Protect all existing or new work from operations which may cause damage such as hauling, welding, soldering, painting, insulation and covering.
- H. All devices and exposed raceways are to be plumb and true. All exposed raceways in finished areas are to be coordinated with the architect/engineer prior to installation.

#### **3.05 SCAFFOLDING**

- A. The contractor shall at his own expense, install, operate, protect, and maintain temporary services such as scaffolding, material hoists, access walks, etc., as may be required.

#### **3.06 SITE UTILITIES**

- A. The contractor may use the existing water and electric power for temporary construction needs.
- B. The owner will direct where these services may be tapped.
- C. Those services that are used during construction, but are to remain, shall be refurbished to a new condition before turning back over to the owner.

### 3.07 CLEAN-UP

- A. Remove all visible temporary tags or labels as well as any protective coverings and wrappings from fixtures and equipment.
- B. Remove all spots, stains, soil, paint, spackle, and other foreign matter from all finished work.
- C. Remove all trash and debris from the premises.

### 3.08 LUBRICATION

- A. Furnish and install and maintain all required lubrication of any equipment operated prior to acceptance by the owner. Lubrication shall be as recommended by the equipment manufacturer.
- B. Provide one year's supply of lubricants to owner at date of acceptance.
- C. Verify that required lubrication has taken place prior to any equipment start-up.

### 3.09 EQUIPMENT START UP

- A. Verify proper installation by manufacturer or his representative.
- B. Advise the architect and engineer two days prior to actual start up.
- C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to the architect and engineer.

### 3.10 OPERATING INSTRUCTIONS AND MANUALS

- A. Properly and fully instruct owner's personnel in the operation and maintenance of all systems and equipment.
- B. Ensure that the owner's personnel are familiar with all operations to carry on required activities.
- C. Such installation shall be for each item of equipment and each system as a whole.
- D. Provide report that instruction has taken place. Include in the report the equipment and/ or systems instructed, date, contractor, owners' personnel, vendor, and that a full operating and maintenance manual has been reviewed.
- E. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalog cuts, wiring diagrams, piping diagrams, control sequences, service requirements, names and addresses of vendors, suppliers, and emergency contacts. Three manuals shall be provided to owner.
- F. Submit manuals for review prior to operating instruction period. Manuals shall be 8 1/2" x 11" with hard cover, suitably bound.
- G. Provide to the owner any special tools necessary to operate any of the equipment.

### 3.11 PENETRATION SEALING

- A. All penetrations of Natatorium walls, fire walls, smoke walls, and floors shall be sealed around conduits and wiring to prevent the flow of gases or smoke.
- B. The sealant shall be foamed in place between the conduit or wiring and the adjacent walls and floors

with Dow/ Corning RTV foam or Fire Stop Caulk.

- C. All penetrations through roof structure shall be coordinated with other trades to minimize the potential for water seepage and leakage through such penetrations.
- D. When electrical boxes are located on opposite side of a fire resistance rated wall assembly are within 2'-0" horizontally of each other, both devices are to be wrapped with Spec Seal Putty Pads as manufactured by Specified Technologies, Inc., or approved equivalent.

### 3.12 EQUIPMENT SETTING

- A. Furnish and install as a minimum, a 0'-4" high concrete pad beneath all floor-mounted equipment.
- B. Furnish and install as a minimum, spring vibration isolators under any equipment 10 HP and over and rubber-in-shear vibration isolation under all equipment less than 10 HP.
- C. Reinforce concrete with No. 4 rods 12'-0" on center, both ways.
- D. Pad to have 3/4" dowels into concrete at one per four square feet.

### 3.13 INSTALLATION MOUNTING HEIGHTS

- A. To be verified by Architect, but in general shall be as follows (top of device elevation above finished floor):

Lighting switches, controls:	3'-10"
Duplex receptacles:	1'-8"
Duplex receptacles over counters:	0'-8" above countertop
Telephone data wall plate and modular jack, desk phone:	1'-8"
Telephone, data wall plate and modular jack, wall phone:	3'-10"
Special outlets:	As required for equipment
Fire alarm annunciating devices:	85"
Fire alarm manual pull stations:	3'-10"
Clock receptacles:	As indicated on drawings.
CATV wall plates and modular jacks:	1'-8"
CATV wall plates and modular jacks mounted near ceiling:	Coordinate mounting height with Architect.
Thermostats (forward reach):	3'-10"
Thermostats (side reach):	3'-10"
Thermostats with lockable cover:	4'-6"

Requirements of the Americans with Disability Act and/or ANSI A117.1 shall be met.

- B. Structural and mechanical details shall be coordinated before roughing in.

### 3.14 COORDINATION

- A. Coordinate with work of other trades prior to installation.
- B. Arrange for minor variations for complete coordinated installation. Provide all necessary offsets to install the work and to provide clearances for other trades.

### 3.15 CUTTING AND PATCHING



- A. Provide for cutting and patching for all electrical work.
- B. Patching to be performed by tradesmen skilled in that particular trade.
- C. Contractor shall patch and repair any existing openings created by the demolition work in floors, walls, partitions, and ceilings not being reused for the new construction.

#### 3.16 BALANCING AND TESTING

- A. Electrically balance connected loads in panels.
- B. The entire wiring system shall be tested to be free from grounds and faults.
- C. Identify all circuits and all phase wiring at terminations.

#### 3.17 EQUIPMENT FURNISHED BY OTHERS

- A. This contractor shall make final electrical connections to equipment furnished by other contractors or the owner.
- B. Provide electrical service, and disconnect equipment as required by code to supply such equipment.

#### 3.18 EXCAVATION, SHORING, PUMPING, BACKFILLING

- A. Perform all excavation required to install the work. Deposit excavated material as so not to create a slide hazard.
- B. Maintain excavations free of water.
- C. Backfill with clean material and pneumatically tamp in 0'-8" layers. Remove excess material, including rock, from site or as directed by the architect and engineer.
- D. Return to original conditions any areas disturbed for excavation.
- E. Install all work neatly, trim, and plumb with building lines.
- F. Install work in spaces allocated.
- G. Cutting and patching shall be performed by skilled tradesmen normally employed for the work involved.

#### 3.19 RECESSES

- A. Furnish information to the General Contractor as to sizes and locations of recesses required to install panels, boxes, grilles, and other equipment, and/ or devices which are to be recessed in walls.
- B. Make offsets or modifications as required to suite final locations.

#### 3.20 LABELING

- A. All equipment panels, controls, safety switches, and devices shall be provided with permanent black laminated micarta white core labels with 3/8" high letters.
- B. This shall also apply to all controllers, remote start/ stop pushbuttons, equipment cabinets, and wherever directed by the architect and engineer.
- C. This shall not apply to individual room thermostats, and local light switches.

#### 3.21 GUARANTEE

- A. All work shall be guaranteed to be free from defects for a period of one year of operation from date of acceptance by the owner unless otherwise specified.

- B. Guarantee shall be extended for all non-operational periods due to failure within the guarantee period.

### 3.22 AS BUILT DRAWINGS

- A. At the completion of the work and prior to final payment, the contractor shall furnish a reproducible as-built drawing to the architect and engineer for approval. The drawings shall indicate all work installed and its actual size, and location and identify all systems installed with locations of concealed devices, conduit, piping and other equipment and complete wiring diagrams of all systems. If acceptable, the architect and engineer will submit the as-built drawings to the owner as record drawings. If not acceptable, the architect and engineer return the drawing to the contractor to make corrections as required. The contractor will resubmit for approval.
- B. The as-built drawings shall indicate measured dimensions of underground lines and other concealed work.
- C. To aid in the preparation of as-built drawings, the engineer can provide the electronic files for use by the contractor. The electronic files will be provided upon execution of the engineer's electronic file release contract prepared specifically for this project. The electronic files will be released in the format used by the architect and engineer to design the project. If this file format is not compatible with the contractor's needs, additional charges for providing the changes to the requested file format may be necessary at \$150.00 per hour billable to the contractor.

### 3.23 GENERAL ELEVATOR REQUIREMENTS

- A. Furnish and install smoke detectors for elevator recall at each elevator lobby when building is three stories or more. These automatic initiation devices are to be interlocked with elevator controller and building Fire Alarm Control Panel. Heat detectors are to be provided in the Machine Room and at the top and bottom of the elevator shaft.
  - 1. For machine room less equipment, devices associated with the Machine Room shall not be required.
- B. When an automatic sprinkler system is present, automatic initiation devices for elevator power shut down are to be provided. These heat detectors are to be located within 2'-0" of all sprinkler heads in the Elevator Machine Room and Elevator Shaft. See Elevator Shunt Trip paragraph for further requirements.
  - 1. For machine room less equipment, devices associated with the Machine Room shall not be required.
- C. Furnish and install fire rated enclosures for the back boxes of any electrical devices recessed in the walls of the elevator equipment room or shaft. Walls are fire rated.

### 3.24 ELEVATOR SHUNT TRIP (SPRINKLED BUILDING)

- A. The elevators are required to be provided with a shunt trip circuit breaker serving the equipment. All feeder circuit breakers (both on normal and emergency/standby power sources) are to be provided with the shunt trip device. The activation of the shunt trip is to be in the sequence described below.
  - 1. Upon activation of the fire alarm system by any manual or automatic means, including the smoke detectors required for recall, a signal is sent from the fire alarm control panel to the elevator controller to initiate recall of the elevator to the lowest non-fire floor. Upon activation of the 135°F heat detector located within 2'-0" of all sprinkler heads in either the Elevator Machine Room, the Elevator Pit or the top of the shaft, a signal is sent from the fire alarm control panel to immediately shunt-trip the power supply. This sequence will allow the

elevator to be recalled to the lowest non-fire floor before the shunt trip is activated. The sprinkler heads in the Elevator Machine Room and elevator shaft are to be rated at 200°F, which will allow the shunt trip to activate prior to the sprinkler head.

**3.25 WORK COMPLETION**

- A. The contractor shall promptly correct work rejected by the engineer or failing to conform to the requirements of the contract documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed, or completed. Costs of correcting such rejected work, including additional testing and inspections and compensation for the engineer’s services and expenses made necessary thereby, shall be at the contractor’s expense.

**3.26 REQUEST FOR INFORMATION (RFI) REQUIREMENTS**

- A. All RFI’s shall include the following information based on AIA Document G716:
  1. To, From, Project Name, Issue Date, RFI number in sequential order with all other trades, Requested Reply Date.
  2. Provide a description with specification and/or drawing references.
  3. Provide the senders recommendation including cost and/or schedule considerations.
  4. Provide receiver’s reply space.
  5. Note an RFI reply is not an authorization to proceed with the work involving additional cost/time.

**3.27 SHOP DRAWING REQUIREMENTS**

- A. The following is a list of required shop drawings for this project.

<b>ELECTRICAL</b>	<b>DATE REC'D</b>	<b>ACTION</b>	<b>DATE REC'D</b>	<b>ACTION</b>
Basic Materials and Equipment (Section 26 05 00 and 26 27 00)				
High Voltage Cable and Equipment				
Fusible Switchboard (Section 26 24 13)				
Panelboards (Section 26 24 16)				
Bus Duct (Section 26 25 00)				
Safety Switches - (Section 26 28 16)				
Automatic Transfer Switch (Section 26 36 23)				
Secondary Unit Substation (Section 26 11 16)				
Packaged Meter Centers (Section 26 27 13)				
Transformers (Section 26 22 00)				

<b>ELECTRICAL</b>	<b>DATE REC'D</b>	<b>ACTION</b>	<b>DATE REC'D</b>	<b>ACTION</b>
Surge Suppression (Section 26 43 13)				
Lighting (Section 26 50 00 and 26 09 00)				
Lightning Protection (Section 26 41 13)				
Emergency Power System (Section 26 30 00)				
Static Uninterruptible Power Supply (Section 26 33 53)				
Fire Alarm and Detection Systems (Section 28 30 00)				
Low Voltage Systems (CCTV, Security, DATA, Phone Entry, etc.)				
As-Builts				
Warranties				
Maintenance Manuals				
Instructions				
Ground Test				

END OF SECTION

## **SECTION 26 01 26 - EXISTING EQUIPMENT TO BE REUSED**

### **PART 1 - GENERAL**

#### 1.01 REFERENCE

- A. Refer to section 26 00 00 for requirements which are applicable to this section.
- B. Refer to National Electrical Testing Association Standards, particularly NETA MTS-1997 and NETA ATS-1999.

#### 1.02 WORK INCLUDED

- A. Provide all labor, material, equipment, and supervision necessary to refurbish existing equipment as specified herein and place into operation.
- B. All work and accessories required to perform the intended work is to be included in the scope of work.

#### 1.03 QUALITY ASSURANCE

- A. Verify that all equipment is installed in accordance with the manufacturer's recommendations.
- B. Install systems and equipment in accordance with current applicable codes.
- C. Provide adequate supervision of labor force to see that installations are complete and correct.
- D. Testing Agency's Field Supervisor and/ or Technicians are to be certified according to NETA ETT-2000.

#### 1.04 SCOPE

- A. It is the intent to totally refurbish existing equipment to as-new operating condition and efficiency. All parts to be made operable, corrosion removed, repainted, adjusted, cleaned, lubricated, and repaired as necessary.
- B. Schedule outages with owner to minimize downtime. Have parts and supplies for repairs available beforehand.

### **PART 2 - PRODUCTS**

#### 2.01 PARTS

- A. Replacement parts shall be manufactured by the original equipment supplier or approved substitute. Any substitute shall be submitted to the engineer for approval prior to use.

### **PART 3 - EXECUTION**

#### **3.01 PANELBOARDS, SWITCHBOARDS, LOAD CENTERS**

- A. Visually inspect enclosures, bus, and all cable terminations. Report signs of cable overheating, insulation degradation, excessive moisture, rust, etc.
- B. Clean, wire-brush, and paint all corroded and rusted areas with Rustoleum/ Gavanoleum to match existing.
- C. Undo cable terminations, as necessary. Clean with approved electrical cleaner and reconnect to manufacturer's recommended torque.
- D. Replace existing overcurrent protection devices with new devices of similar kAIC ratings. This applies to all overcurrent protection devices rated 100 Amps, or less, and more than 20 years old.
- E. Switchboard fused switches are to be cycled on/ off several times to ensure operability. Lubricate pivot point(s) as necessary, and/ or as recommended by the manufacturer.
- F. Provide fuse clamps for each fused switchboard switch exceeding 100 Amps.

#### **3.02 TRANSFORMERS**

- A. Visually inspect enclosure, bus, or cable terminations. Report signs of cable overheating, insulation degradation, excessive moisture, rust, etc.
- B. Clean, wire-brush, and paint all corroded and rusted areas with Rustoleum/ Gavanoleum to match existing.
- C. Undo cable terminations, as necessary. Clean with approved electrical cleaner and reconnect to manufacturer's recommended torque.
- D. Vacuum coils, core, and enclosure. Blow out with dry Nitrogen.
- E. Megger transformer, report test results and return to operation.

#### **3.03 SAFETY SWITCHES**

- A. Visually inspect enclosure, bus, or cable terminations. Report signs of cable overheating, insulation degradation, excessive moisture, rust, etc.
- B. Clean, wire-brush, and paint all corroded and rusted areas with Rustoleum/ Gavanoleum to match existing.
- C. Cycle switch(es) on/ off to ensure operability. Lubricate pivot point(s) as necessary as recommended by manufacturer.
- D. Replace switch as necessary.

#### **3.04 AUTOMATIC TRANSFER SWITCHES**

- A. Visually inspect enclosure, bus, or cable terminations. Report signs of cable overheating, insulation degradation, excessive moisture, rust, etc.
- B. Clean, wire-brush, and paint all corroded and rusted areas with Rustoleum/ Gavanoleum to match existing.
- C. Tighten all control terminations.
- D. Undo cable terminations, as necessary, clean with approved electrical cleaner, and reconnect to manufacturer's recommended torque.

E. Test to ensure proper operation of transfer sequence, cycling, etc.

### 3.05 DIESEL GENERATOR SET

- A. Visually inspect enclosure, bus, or cable terminations. Report signs of cable overheating, insulation degradation, excessive moisture, rust, etc.
- B. Clean, wire-brush, and paint all corroded and rusted areas with Rustoleum/ Gavanoleum to match existing.
- C. Tighten all control terminations.
- D. Undo cable terminations, as necessary, clean with approved electrical cleaner, and reconnect to manufacturer's recommended torque.
- E. Drain engine coolant. Fill with new coolant as recommended by manufacturer.
- F. Drain engine oil. Replace filter. Fill with new oil as recommended by manufacturer.
- G. Replace air filter, fuel filter, etc.
- H. Drain diesel fuel. Fill with new fuel as recommended by manufacturer.
- I. All diesel engine work shall be performed by a factory authorized technician.
- J. Test to ensure proper operation under full load. Provide load bank of appropriate size.
- K. Test to ensure proper operation of load transfer with existing automatic transfer switch and building load.

END OF SECTION

## SECTION 26 05 00 - FIRE-STOPPING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Refer to section 26 00 00 for requirements which are applicable to this section.
- B. Refer to International codes.
- C. Section includes:
  - 1. Through-penetration fire stops and smoke-stops for all fire-rated bearing and non-bearing wall and floor assemblies, both blank (empty) and those accommodating penetrating items such as cables, conduits, pipes, ducts, etc.

#### 1.02 REFERENCES

- A. American Society for Testing and Materials Standards (ASTM):
  - 1. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 2. ASTM E814: Standard Test method for Fire Tests of Through-Penetration Fire Stops.
- B. Underwriters Laboratories, Inc.:
  - 1. UL 723 Surface Burning Characteristics of Building Materials
  - 2. UL 1479 Fire Tests of Through-Penetration Fire Stops.
- C. UL Fire Resistance Directory:
  - 1. Through Penetration Fire Stop Devices (XHJI)
  - 2. Fire Resistive Ratings (BXUV)
  - 3. Through Penetration Fire Stop Systems (XHEZ)
  - 4. Fill, Void, or Cavity Material (XHHW)

#### 1.03 DEFINITIONS

- A. FIRE-STOPPING: The use of a material or combination of materials in a fire rated structure (wall or floor) where it has been breached to restore the integrity of the fire rating on that wall or floor.
- B. SYSTEM: The use of a specific fire stop material or combination of materials in conjunction with a specific wall or floor construction type and a specific penetrant(s), constitutes a "System."
- C. BARRIER: Any bearing or non-bearing wall or floor that has an hourly fire and smoke rating.
- D. THROUGH-PENETRATION: Any penetration of a fire-rated wall or floor that completely breaches the barrier.
- E. MEMBRANE-PENETRATION: Any penetration in a fire rated wall that breaches only one side of the barrier.
- F. CONSTRUCTION GAPS: any gap, joint, or opening, whether static or dynamic, where the top of a wall may meet a floor; wall-to-wall applications; edge-to-edge floor configurations; floor-to-exterior wall; or any linear breach in a rated barrier. Where movement is required, the fire stopping system must comply with UL2079 for dynamic joints.



#### 1.04 SUBMITTALS

NOTE: A “Certificate of Conformance” from the manufacturers listed in Section “2.02 ACCEPTABLE MANUFACTURERS,” is required with the “Submittal Package” to ensure that the material selected meets all of the criteria of this specification as set forth in Section “1.05 QUALITY ASSURANCE.”

- A. Submit manufacturer’s product literature for each type of fire-stop material to be installed. Literature shall indicate product characteristics, typical uses, performance and imitation criteria, and test data. Submittal shall comply with Section 26 00 00.
- B. Material Safety Data Sheets (MSDS): Submit MSDS for each fire-stop product.
- C. UL Tested Systems: Submit drawings showing typical installation details for the methods of installation. Indicate which fire-stop materials will be used and thickness(es) for different hourly ratings.
- D. Engineering Judgments: Submit manufacturer’s drawings for all non-standard applications where no UL tested system exists. All drawings must indicate the “Tested” UL system upon which the judgment is based to assess the relevance of the judgment to some, known performance.
- E. Submit manufacturer’s installation procedures for each type of product.
- F. Approved Applicator: Submit document from manufacturer wherein manufacturer recognizes the installer as qualified or submit a list of past projects to demonstrate capability to perform intended work.
- G. Upon completion, installer shall provide written certification that materials were installed in accordance with the manufacturer’s installation instructions and details.

#### 1.05 QUALITY ASSURANCE

- A. Fire-stopping systems (materials and design):
  - 1. Shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests in a configuration that is representative of field conditions.
    - a. The F rating must be minimum of one hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.
  - 2. For joints, must be tested to UL 2079 with movement capabilities equal to those of the anticipated conditions.
- B. Fire-stopping materials and systems must be capable of closing or filling through openings created by:
  - 1. The burning or melting of combustible pipes, cable jacketing, or pipe insulation materials, or.
  - 2. Deflection of sheet metal due to thermal expansion (electrical and mechanical duct work).
- C. Fire-stopping material shall be asbestos and lead-free and shall not incorporate nor require the use of hazardous solvents.
- D. Fire-stopping sealants must be flexible, allowing for normal pipe movement.
- E. Fire-stopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.
- F. Fire-stopping materials shall be moisture resistant and may not dissolve in water after curing.

- G. All fire-stopping materials shall be manufactured by one manufacturer (to the maximum extent possible).
- H. Installation of fire-stopping systems shall be performed by a contractor (or contractors) trained or approved by the fire-stop manufacturer.
- I. Material used shall be in accordance with the manufacturer's written installation instructions.

#### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver material in the manufacturer's original, unopened containers or packages with the manufacturer's name, product identification, lot number, UL label and mixing and installation instructions as applicable.
- B. Store materials in the original, unopened containers or packages and under conditions recommended by the manufacturer.
- C. All fire-stop materials will be installed prior to expiration of shelf life.

#### 1.07 PROJECT CONDITIONS

- A. Conform to manufacturer's printed instructions for installation and when applicable, curing in accordance with temperature and humidity. Conform to ventilation and safety requirements.
- B. Contractor shall verify the condition of the substrates before starting work.
- C. Weather Conditions: Do not proceed with installation of fire-stop materials when temperatures fall outside the manufacturer's suggested limits.
- D. Care shall be taken to ensure that fire-stopping materials are installed so as not to contaminate adjacent surfaces.

#### 1.08 SEQUENCING

- A. Schedule fire-stopping after installation of penetrants but prior to concealing the openings.
- B. Fire-stopping shall precede gypsum board finishing.

#### 1.09 PROTECTION

- A. Where fire-stopping is installed at locations which will remain exposed in the completed work, provide protection as necessary to prevent damage to adjacent surfaces and finishes, and protect as necessary against damage from other construction activities.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Fire-stopping materials and systems shall meet the requirements specified herein.
- B. Architect must approve in writing any alternates to the materials and system specified herein.
- C. All fire-stop products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the thermal and fire resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.
- D. For applications where combustible penetrants are involved, i.e., insulated, and plastic pipe,

a suitable intumescent material must be used.

## 2.02 ACCEPTABLE MANUFACTURERS

NOTE: Inclusion of materials in this specification does not indicate that the listed products have been evaluated for conformance to this specification. Therefore, the user/ contractor must certify in the submittal package, with a “Certificate of Conformance” from the manufacturers listed below, that the material selected meets all of the criteria set forth in Section “1.05 QUALITY ASSURANCE” of this specification.

- A. Specified Technologies, Inc. /GE Pensil® (STI), Somerville, NJ 08876, Phone: (800) 992-1180.
- B. 3M Fire Protection Products, St. Paul, MN

## 2.03 MATERIALS

- A. Intumescent Fire-stop Sealants and Caulks:
  - 1. STI SpecSeal SSS100
  - 2. 3M Fire Barrier Caulk CP25WB+
- B. Latex Fire-stop Sealant
  - 1. STI SpecSeal LC150 Sealant
- C. Elastomeric Water-Based Sealant
  - 1. STI SpecSeal ES100 Elastomeric Sealant
- D. Silicone Fire-stop Sealants and Caulks:
  - 1. STI SpecSeal Pensil 300
  - 2. 3M Fire Barrier Silicone Sealants
- E. Fire-stop Putty:
  - 1. STI SpecSeal Fire-stop Putty Bars and Pads
  - 2. 3M Fire Barrier Moldable Putty
- F. Fire-stop Collars:
  - 1. STI Spec Seal Fire-stop Collars
  - 2. 3M Fire Barrier PPD's.
- G. Wrap Strips:
  - 1. SpecSeal Wrap Strip
  - 2. 3M Fire Barrier FS195 Wrap Strip.
- H. 2-Part Silicone Fire-stop Foam:
  - 1. STI SpecSeal Pensil 200
  - 2. 3M Fire Barrier 2001 Silicone Foam.
- I. Fire-stop Mortar:
  - 1. STI SpecSeal Mortar.
- J. Fire-stop Pillows:
  - 1. STI SpecSeal Pillows
- K. Elastomeric Spray:
  - 1. STI SpecSeal AS Elastomeric Spray
- L. Composite Board:
  - 1. 3M Barrier Sheet Material
- M. Accessories:
  - 1. Forming/Damming Materials: Mineral fiberboard or other type as per manufacturer recommendation.

## **PART 3 - EXECUTION**

### **CONDITIONS REQUIRING FIRE-STOPPING**

- A. General:
  - 1. Provide fire-stopping for conditions specified whether fire-stopping is indicated or not, and if indicated, whether such material is designed as insulation, safing, or otherwise.
- B. Through-Penetrations:
  - 1. Fire-stopping shall be installed in all open penetrations and in the annular space in all penetrations in any bearing or non-bearing fire-rated barrier.
- C. Membrane-Penetrations:
  - 1. Where required by code, all membrane-penetrations in rated walls shall be protected with fire-stopping products that meet the requirements of third-party time/temperature testing.
- D. Construction Joints/ Gaps:
  - 1. Fire Stopping shall be provided:
    - a. Between the edges of floor slabs and exterior walls.
    - b. Between the tops of walls and the underside of floors
    - c. In the control joint in masonry walls and floors
    - d. In expansion joints.
- E. Smoke-Stopping:
  - 1. As required by the other Sections, smoke-stops shall be provided for through-penetrations, membrane-penetrations, and construction gaps with a material approved and tested for such application.

### **3.02 EXAMINATION**

- A. Examine the areas and conditions where fire-stops are to be installed and notify the architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable to the architect.
- B. Verify that environmental conditions are safe and suitable for installation of fire-stop products.
- C. Verify that all pipe, conduit, cable, and other items which penetrate fire-rated construction have been permanently installed prior to installation of fire-stops.

### **3.03 INSTALLATION**

- A. General:
  - 1. Installation of fire-stops shall be performed by an applicator/ installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
  - 2. Apply fire-stops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
  - 3. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.

4. Seal holes and penetrations to ensure an effective smoke seal.
5. In areas of high traffic, protect fire-stopping materials from damage. If the opening is large, install fire-stopping materials capable of supporting the weight of a human.
6. Insulation types specified in other sections shall not be installed in lieu of fire-stopping material specified herein.
7. All combustible penetrants (e.g., non-metallic pipes or insulated metallic pipes) shall be fire-stopped using products and systems tested in a configuration representative of the field condition.

B. Dam Construction:

1. When required to properly contain fire-stopping materials within openings damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Non-combustible damming materials may be left as a permanent component of the fire-stop system.

3.04 FIELD QUALITY CONTROL

1. Prepare and install fire-stopping systems in accordance with manufacturer's printed instructions and recommendations.
2. Follow safety procedures recommended in the Material Safety Data Sheets.
3. Finish surfaces of fire-stopping which are to remain exposed in the completed work to a uniform and level condition.
4. All areas of work must be accessible until inspection by the applicable Code Authorities.
5. Correct unacceptable fire-stops and provide additional inspection to verify compliance with this specification.

3.05 CLEANING

1. Remove spilled and excess materials adjacent to fire-stopping without damaging adjacent surfaces.
2. Leave finished work in neat, clean condition with no evidence of spill overs or damage to adjacent surfaces.

END OF SECTION

## SECTION 26 09 00- LIGHTING CONTROLS

### PART 1 - GENERAL

#### 1.01 REFERENCE

- A. This section includes manually operated, digital lighting controls with external signal source, relays, and control module.
- B. Refer to Section 26 00 00 for other requirements of this section.
- C. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.
- D. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
- F. Comply with NFPA 70 National Electrical Code (NEC).
- G. Refer to 26 27 00 for other lighting controls (switches, motion sensors, etc.).
- H. Provide interior lighting controls to meet the adopted IBC / IECC / ASHRAE 90.1 code.

#### 1.02 WORK INCLUDED

- A. Provide all labor, material, equipment, and supervision necessary to furnish and install complete, operating, lighting control system specified herein.
- B. All rooms are to be provided with lighting controls. Provide manual switch and code required control devices as appropriate. If controls are not indicated within a space, controls are to be provided for the space in a similar manner as adjacent or similar spaces.

#### 1.03 SUBMITTALS

- A. Product Data: For control modules, power distribution components, manual switches and plates, and conductors and cables.
- B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.
  - 1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
  - 2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
  - 3. Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
- C. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and system specified in other Sections.
  - 1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.

2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet inter-operability requirements of the network protocol.
  3. Show equipment locations on floor plans of similar scale as contract documents.
- D. Field quality control test reports.
- E. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
- F. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

#### 1.04 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
1. Match components and interconnections for optimum performance of lighting control functions.
  2. Coordinate lighting controls with HVAC controls. When specifically indicated on lighting control system riser diagram, design display graphics showing building areas controlled; include the status of lighting controls in each area.
  3. Coordinate lighting controls with that in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

#### 1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Failure of software input/output to execute switching or dimming commands.
    - b. Failure of modular relays to operate under manual or software commands.
    - c. Damage of electronic components due to transient voltage surges.
  2. Warranty Period: Two years from date of Substantial Completion.

#### 1.06 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Leviton Mfg. Company Inc.

2. Hubbell Lighting Controls.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Lutron Electronics Company, Inc.
5. ETC Lighting Control Systems.
6. Watt Stopper (The).

## 2.02 SYSTEM REQUIREMENTS

- A. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.
- B. Performance Requirements: Manual switch operation, an internal timing and control unit and external sensors, send a signal to Programmable system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits to groups of lighting fixtures or other loads.

## 2.03 CONTROL MODULE

- A. Control Module Description: Comply with UL 508 (CSA C22.2, No. 14); Microprocessor based, programmable, control unit; mounted in preassembled, modular relay panel. Low-voltage-controlled, latching-type, single-pole lighting circuit relays shall be prime output circuit devices. Where indicated, a limited number of digital or analog, low-voltage control-circuit outputs shall be supported by control unit and circuit boards associated with relays. Control units shall be capable of receiving inputs from sensors and other sources. Line-voltage components and wiring shall be separated from low-voltage components and wiring by barriers. Control module shall be locally programmable.

## 2.04 POWER DISTRIBUTION COMPONENTS

- A. Modular Relay Panel: Comply with UL 508 (CSA C22.2, No. 14) and UL 916 (CSA C22.2, No. 205); factory assembled with modular single-pole relays, power supplies, and accessory components required for specified performance.
  1. Cabinet: Steel with hinged, locking door.
    - a. Barriers separate low-voltage and line-voltage components.
    - b. Directory: Mounted on back of door. Identifies each relay as to load groups controlled and each programmed pilot device if any.
    - c. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.
  2. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type.
    - a. Low-Voltage Leads: Plug connector to the connector strip in cabinet and pilot light power where indicated.
    - b. Rated Capacity (Mounted in Relay Panel): 20 A, 125-V ac for tungsten filaments; 20 A, 277-V ac for ballasts.
    - c. Endurance: 50,000 cycles at rated capacity.
    - d. Mounting: Provision for easy removal and installation in relay cabinet.

## 2.05 MATERIALS



- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Division 26 27 00 Section "BASIC MATERIALS."
- B. Class 1, 2, and 3 Control Cables: Multi-conductor cable with copper conductors as recommended by the manufacturer.
- C. Control wiring methods are to be per approved brand and part number of the lighting control manufacturer. No substitutions will be permitted.
- D. Manual Controllers: Comply with Division 26 27 00 Section "BASIC MATERIALS."

### **PART 3 - EXECUTION**

#### **3.01 WIRING INSTALLATION**

- A. Comply with NECA 1.
- B. Wiring Method: Install wiring in raceways except where installed in accessible ceilings.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- D. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- E. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.

#### **3.02 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 assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Test for circuit continuity.
  - 2. Verify that the control module features are operational.
  - 3. Check operation of local override controls.
  - 4. Test system diagnostics by simulating improper operation of several components.

#### **3.03 SOFTWARE INSTALLATION**

- A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

#### **3.04 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors and to assist Owner's personnel in making program changes to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

### 3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software training for PC-based control systems.

END OF SECTION

## **SECTION 26 27 00 - BASIC MATERIALS AND EQUIPMENT FOR METAL RACEWAY SYSTEMS**

### **PART 1 - GENERAL**

#### 1.01 REFERENCE

- A. Refer to Section 26 00 00 for additional requirements of this section.
- B. Refer to NECA 1-2000 for general installation requirements.

#### 1.02 SUBMITTALS

- A. Submit shop drawings and manufacturer's catalog sheets of all specified items unless waived by the engineer.
- B. Submit switches and receptacles as a minimum.

### **PART 2 - PRODUCTS**

#### 2.01 RIGID METAL CONDUIT (GRS)

- A. Material; Steel, Zinc coated Federal Specification WW-C-581d, ANSI C801.
- B. Fittings; Malleable iron, Threaded
- C. NEC; Article 344
- D. Application; Indoor, above ground, enamel coated, all occupancies not subject to severe corrosive influences.
- E. Manufacturer; Hubbell, Allied Tube and Conduit Corp. or approved equal.

#### 2.02 ELECTRICAL METALLIC TUBING (EMT)

- A. Material; Galvanized steel, U.L. labeled, Federal Specification ANSI C80.3.
- B. Fittings; Threadless compression type for up to 1-1/4", set screw for 1-1/2" and larger. Installation in accordance with Article 358 of the National Electrical Code and U.L. general information card #FJMX.
- C. NEC; Article 358
- D. Application; Exposed and concealed work not subject to physical damage.
- E. Manufacturer; Hubbell, Allied Tube and Conduit Corp. or approved equal.

#### 2.03 FLEXIBLE METAL TUBING (FMT)

- A. Material; Hot dipped galvanized interlocking convolutions of steel tape in circular cross section. Federal Specification AA-55810
- B. Fittings; Hot dipped galvanized steel

- C. NEC; Article 344
- D. Application; All areas other than wet locations, hoistways, hazardous locations, below ground, and areas with exposure to oil, gasoline, or other materials having an adverse effect on rubber.
- E. Manufacturer; Electri-flex Company Liquatite Type BR, Hubbell, Allied Tube and Conduit Corp., AFC.

#### 2.04 RIGID NON-METALLIC CONDUIT (SCHEDULE 40 PVC)

- A. Material; U.L. 651, ANSI/ NEMA TC-2, Federal Military Specification WC-1094A, 90 °C wire rated and sunlight resistant.
- B. Fittings; PVC, same as above.
- C. NEC; Article 352
- D. Application; In walls, floors, ceilings, wet locations, underground, and locations subject to severe corrosive influences.
- E. Manufacturer; Carlon Schedule 40 electrical conduit or approved equal.

#### 2.05 LIQUATITE FLEXIBLE METAL CONDUIT

- A. Material: Hot dipped galvanized interlocking convolutions of steel tape in circular cross section with PVC jacket.
- B. Fittings: Hot dipped galvanized steel.
- C. NEC Article 350 (LFMC)
- D. Application: All areas other than elevator hoistways, hazardous locations and where subject to physical damage.
- E. Manufacturers: Electriflex Company Liquatite Type LT, Hubbell, Allied Tube and Conduit Corp., AFC.

#### 2.06 CONDUCTORS

- A. Type; THHN, 98% conductivity copper, 600-volt, dry locations. Type THWN for wet locations. Conductors shall be U.L. listed.
- B. Equipment terminations for circuits rated 100 Amps or less (#14 AWG - #2 AWG) shall be rated 60 °C (140 °F). Equipment termination for circuits rated over 100 Amps (#1 or larger) shall be rated 75 °C (167 °F). Refer to NEC for allowable exceptions. 90 °C (194 °F) rated conductors shall be used as indicated on the drawings or as indicated within these specifications.
- C. Solid copper conductors for #10 and #12 wire size. #8 and larger are to be stranded copper.
- D. Separate green ground conductor for all circuits including branch, homerun, and feeders.
- E. All conductors shall be color coded as follows:
  - 120/ 208 Volt Systems
    - Phase A      Black
    - Phase B      Red
    - Phase C      Blue
    - Neutral Grey or Natural White
  - 277/ 480 Volt Systems
    - Phase A      Brown

Phase B      Orange  
Phase C      Yellow  
Neutral Grey or Natural White

- F. Minimum size conductor shall be #12 AWG except that #14 AWG shall be used for control wiring. All circuit conductors shall be run in the same raceway system.
- G. A grounding conductor shall be provided to each electrical device in accordance with the National Electrical Code.
- H. Conductor sizes are to be as indicated on the drawings and/ or as specified in this specification.
- I. Conductors are not to be installed in raceways until construction is advanced to allow conductors to be installed completely without damage to conductors and there is not possibility of water or other contaminants entering the raceway system. Conductors shall be installed between convenient terminating points.
- J. An approved pulling compound shall be used to assist in pulling of conductors.
- K. Aluminum Alloy Conductors for Distribution Feeder Applications:
  - 1. Distribution feeder conductor's sizes #6 AWG to 1000 Kcmil may be copper (Base Bid) or aluminum alloy (Alternate). Aluminum alloy conductors are to be compact standard conductors of a recognizable Aluminum Association 8000 Series aluminum alloy conductor material (AA-8000 series alloy). AA-8000 series alloy conductor must be Alcan Cable Stabiloy or approved equal.
  - 2. Compliance with the elongation requirement per Table 10.1 of UL Standard 1581 for stranded AA-8000 series aluminum alloy conductors shall be determined on wires taken from the conductor after stranding by manufacturer.
  - 3. Insulation:
    - a. For use in raceways: Type XHHW-2, temperature rating 90 °C.
    - b. For use in cable trays: Sizes #1/ 0 AEG and larger. Type XHHW-2, temperature rating 90o C and marked: "SUN RES", "VW-1", "GASOLINE AND OIL-RESISTANT II", "FOR CT USE".
- L. Manufacturers: Alpha Wire, Southwire, Tamaqua Cable, Triangle Wire & Cable, American Insulated Wire, BICC or General Cable.

## 2.07 JUNCTION BOXES

- A. Material; Galvanized steel, accessible.
- B. Manufacturers; Keystone, Hubbell, Penn Panel and Box Co.
- C. NEC; Article 314

## 2.08 OUTLET AND SWITCH BOXES

- A. Material; Galvanized steel with knockouts to suit raceway system.
- B. Manufacturer; Crouse Hinds Co., Steel City Div., Raco Inc., or approved equal.

## 2.09 WALL PLATES - METAL- COMMERCIAL SPECIFICATION GRADE

- A. Wall plates shall be standard size, metal, commercial grade.
- B. Plates shall be provided for all switches, receptacles, blanks, telephone, and special purpose outlets.

- C. Plates must be of modern design having rounded edges and corners and be complete with color-matched mounting screws.
  - D. Plates must be of one design throughout the building and shall conform to UL, CSA, and NEMA standards.
  - E. Engraving shall be done by plate manufacturer in accordance with the schedule.
  - F. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, Leviton.
- 2.10 WALL PLATES - STAINLESS STEEL - TYPE 302 - CORROSIVE/ DAMPNES/ FOOD SERVICE DUTY
- A. Wall plates shall be Pass and Seymour Sierra Series “S”, Type 430 Stainless Steel, or “S-N” line Type 302 Stainless Steel or equal and will conform to UL and NEMA standards.
  - B. Plates must be provided for all switches, receptacles, blanks, telephone and special purpose outlets.
  - C. Plates shall be of a modern design, having rounded edges and corners and be complete with finish-matching mounting screws.
  - D. Engraving shall be done by plate manufacturer in accordance with the schedule.
  - E. Plates must be of one design throughout the building.
  - F. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
- 2.11 RECEPTACLES - STANDARD DUTY - COMMERCIAL/ SPECIFICATION GRADE
- A. All thermoplastic nylon body construction.
  - B. Impact-resistant nylon face.
  - C. One-piece triple-wipe brass power contact.
  - D. Available with side and back wire capable of accepting #14 - #10 AWG copper or copper-clad wire.
  - E. Terminal compartments isolated from each other for positive conductor containment.
  - F. Automatic grounding clip assures grounding to metallic boxes.
  - G. Easily accessible break off tabs to facilitate split circuit wiring.
  - H. Plated steel strap for corrosion resistance.
  - I. Combination Phillips/ slotted head screws backed out for ease of installation.
  - J. In compliance with UL 498.
  - K. Pre-wired pigtail connectors that accommodate Federal Specification Receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
  - L. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
  - M. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
  - N. Leviton 5362/ 5361, 20 Amp, ivory, white, grey, black, brown or almond.
- 2.12 RECEPTACLES - DECORA - SPECIFICATION GRADE
- A. Impact-resistant nylon face.
  - B. One-piece, triple-wire brass power contacts.
  - C. Corrosion resistant, plated, wrap-around steel strap locked into assembly to prohibit strap from bending away from body.
  - D. Terminal compartments isolated from each other for positive conductor containment.

- E. Available in hospital grade & specification grade.
- F. Heavy-duty compact design for easier installation and long-lasting performance.
- G. Automatic grounding clip standard for positive ground to metal boxes.
- H. All devices fit standard #26 opening wall plate.
- I. Side and back wire accepts #14 - #10 AWG.
- J. In compliance with UL 498.
- K. Pre-wired pigtail connectors that accommodate Federal Specification Receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
- L. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
- M. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
- N. Leviton 16352, 20 Amp, white, ivory, grey, black, or almond.

\* Those receptacles installed on the emergency system shall be clearly identifiable as distinct from normal system receptacles. (Red)

#### 2.13 GROUND FAULT CIRCUIT INTERRUPTING RECEPTACLES - STANDARD GRADE

- A. Side or screw pressure plate back wire with #14 or #12 AWG solid or y-stranded copper wire.
- B. Extra-long strap.
- C. High-impact resistant thermoplastic construction.
- D. Ground screw with a wire guide channel.
- E. Dual-direction test and reset buttons.
- F. Line and load terminations supplied backed out, and ready to wire.
- G. Two back wire holes per terminal.
- H. Ultrasonic welding of face to back body.
- I. Mis-wire label applied to load terminals.
- J. GFCI receptacles are to have SafeLock protection. If critical components are damaged and ground fault protection is lost or if mis-wired, power to receptacle is disconnected.
- K. Class A rated GFCI
- L. 1-1/2 HP rating on Motor Control GFCI switch (2081 series).
- M. Button colors match the device face.
- N. Supplied with matching wall plate.
- O. In compliance with UL-943, UL-498, UL-508.
- P. Pre-wired pigtail connectors that accommodate Federal Specification receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
- Q. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
- R. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
- S. Leviton 6898, 20 Amp, ivory, white, almond, or mahogany.

#### 2.14 TAMPER RESISTANT RECEPTACLES - COMMERCIAL

- A. Thermoplastic shutter for reliable tamper-resistant design.
- B. High-impact thermoplastic face and body.
- C. One-piece Brass Alloy grounding system.

- D. High performance copper alloy contacts assure the highest degree of blade retention.
- E. Ground contacts are encapsulated in thermoplastic body.
- F. Side or back wiring accepts #10, #12 or #14 AWG copper.
- G. Eight hold back wiring for convenient feed thru wiring.
- H. In compliance with UL-498.
- I. Pre-wired pigtail connectors that accommodate Federal Specification receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
- J. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
- K. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
- L. Leviton 8300-SG, 20 Amp, ivory, white, grey, red or brown.

#### 2.15 TAMPER RESISTANT RECEPTACLES - DECORA

- A. Thermoplastic shutter for reliable tamper-resistant design.
- B. High-impact thermoplastic face and body.
- C. One-piece Brass Alloy grounding system.
- D. High performance copper alloy contacts assure the highest degree of blade retention.
- E. Ground contacts are encapsulated in thermoplastic body.
- F. Side or back wiring accepts #10, #12 or #14 AWG copper.
- G. 8-hold back wiring for convenient feed thru wiring.
- H. In compliance with UL-498.
- I. Pre-wired pigtail connectors that accommodate Federal Specification Receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
- J. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
- K. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
- L. Leviton 16262-SG, 20 Amp, ivory, white, red or orange.

#### 2.16 ISOLATED GROUND RECEPTACLES - COMMERCIAL/ SPECIFICATION GRADE

- A. All thermoplastic body construction.
- B. Impact-resistant nylon face.
- C. One-piece triple-wipe brass power contact.
- D. Available with side wiring only & side and back wire models capable of accepting #14 - #10 AWG copper or copper-clad wire.
- E. Terminal compartments isolated from each other for positive conductor containment.
- F. Automatic grounding clip assures grounding to metallic boxes.
- G. Easily accessible break off tabs to facilitate split circuit wiring.
- H. Plated steel strap for corrosion resistance.
- I. Combination Phillips/ slotted head screws backed out for ease of installation.
- J. In compliance with UL 498, NEMA WD-1.
- K. Pre-wired pigtail connectors that accommodate Federal Specification Receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
- L. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
- M. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.



N. Leviton 8300-IG, 20 Amp, orange.

## 2.17 ISOLATED GROUND RECEPTACLES - DECORA - HOSPITAL AND SPECIFICATION GRADE

- A. Impact-resistant nylon face.
- B. One-piece, triple-wire brass power contacts.
- C. Corrosion resistant, plated, wrap-around steel strap locked into assembly to prohibit strap from bending away from body.
- D. Terminal compartments isolated from each other for positive conductor containment.
- E. Available in hospital grade & specification grade.
- F. Heavy-duty compact design for easier installation and long-lasting performance.
- G. Automatic grounding clip standard for positive ground to metal boxes.
- H. All devices fit standard #26 opening wall plate.
- I. Side and back wire accepts #14 - #10 AWG.
- J. In compliance with UL 498.
- K. Pre-wired pigtail connectors that accommodate Federal Specification Receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
- L. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
- M. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
- N. Leviton 16362 - IG, 20 Amp, orange.

## 2.18 RECEPTACLES - FLOOR OUTLET

- A. Solid brass covered plate with matching flush fitting brass cap.
- B. Receptacle made of durable thermoplastic.
- C. Supplied with foam rubber gasket. O-ring and metal, 18" cubic box.
- D. In compliance with UL 498.
- E. Pre-wired pigtail connectors that accommodate Federal Specification receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
- F. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
- G. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
- H. Leviton 5362/ 5361, 20 Amp, ivory, white, grey, black, brown, or almond.

## 2.19 TOGGLE SWITCHES - COMMERCIAL DUTY SPECIFICATION GRADE

- A. One-piece brass alloy contact arm.
- B. Thermoset body and cover for superior heat resistance.
- C. High strength polycarbonate toggle resists breaking and chipping under heavy abuse.
- D. Available with side wire or side and back wire models capable of accepting #14 - #10 AWG copper or copper-clad wire.
- E. Cam designed for fast make with positive break action to minimize arcing and prolong switch life.
- F. Heavy-duty toggle bumpers for smooth and quiet operation.
- G. Oversized silver alloy contacts for longer dependable switch life.

- H. Plated steel strap for corrosion resistance.
- I. Combination Phillips/ slotted head screws backed out for ease of installation.
- J. In compliance with UL 20.
- K. Switches shall be Federal Specification WC596 compliant. Marking should be clearly identifiable on face or strap.
- L. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
- M. Leviton CS120-2/ CS320-2/ CS420-2, 20 Amp, 120/ 277 V, ivory, white, black, grey, or almond.

## 2.20 ROCKER SWITCHES - SPECIFICATION GRADE

- A. Impact-resistant thermoplastic nylon back body and frame.
- B. Cushioned nylon paddle assures smooth, quiet, long-term operation.
- C. Unique single rocking butterfly contact provides long term consistent performance with significantly fewer moving parts.
- D. Internal back and side wire capability for easy installation with #14 – 10 AWG stranded or solid copper/ copper clad wire. Terminals made of high conductivity brass and serrated for maximum wire gripping.
- E. Color-coded back bodies for positive identification of switch rating.
- F. Silver alloy contacts integrally formed to the butterfly actuator assures reliable performance.
- G. Integral auto ground clip for positive ground to metal boxes.
- H. Brass binding head terminal screws are combination Phillips/ slotted. All terminal screws backed out, ready to install.
- I. In compliance with UL 20.
- J. Switches are to be Federal Specification, WC596 compliant. Marking should be clearly identifiable on face or strap.
- K. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
- L. Leviton 5621-2/ 5623-2/ 5624-2, 20 Amp, 120/ 277V ivory, white, black, grey, almond.

## 2.21 LIGHTED ROCKER SWITCHES - SPECIFICATION GRADE

- A. Impact-resistant thermoplastic back body and frame.
- B. Cushioned thermoplastic paddle assures smooth, quiet, long-term operation.
- C. Unique single rocking butterfly contact provides long term consistent performance with significantly fewer moving parts.
- D. Internal back & side wire capability for easy installation with #14 - 10 AWG stranded or solid copper/ copper clad wire. Terminals made of high conductivity brass and serrated for maximum wire gripping.
- E. Color-coded back bodies for positive identification of switch rating.
- F. Silver alloy contacts integrally formed to the butterfly actuator assures reliable performance.
- G. Integral auto-ground clip for positive ground to metal boxes.
- H. Brass binding head terminal screws are combination Phillips/ slotted. All terminal screws backed out, ready to install.
- I. In compliance with UL 20.
- J. Switches are to be Federal Specification, WC596 compliant. Marking should be clearly identifiable on face or strap.
- K. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.

- L. Leviton 5631-2/ 5633-2/ 5659-2/ 5649-2, 20 Amp 120/ 277V, ivory, white, brown, black, red, grey, or light almond.

## 2.22 AC MOTOR RATED SWITCH

- A. 30 Amp and/ or 40 Amp, 600 V AC rated.
- B. Double-pole or triple-pole, single-throw.
- C. UL 508, UL 94 (flammability) Listed.
- D. All molded parts are made of thermoplastic material to assure superior resistance to repeated impact, chemical degradation, extreme temperature fluctuations, tracking and arcing.
- E. Positive-contact design enhances fast make/ slow break mechanism by minimizing bounce and arcing upon contact closure and teasing upon separation.
- F. Free-travel toggle design protects closed contacts from accidental disengagement and contact teasing.
- G. Silver alloy contacts provide maximum conductivity and prolonged service life.
- H. Side and back wire terminal screws accept up to #10 AWG solid copper wire.
- I. For standard #8 AWG wire, remove terminal clamp and use ring terminal.
- J. Oversized #10, triple-combination, vibration-resistant terminal screws.
- K. Mounting yoke is made from nickel-plated brass for superior corrosion resistance.
- L. Insulating barriers between terminal screws provide isolation from each phase.
- M. Devices are permanently marked with catalog number, Amperage, voltage, and horse-power ratings to assist with identification.
- N. Large toggle provides positive actuation, even when operated with gloved hand.
- O. Leviton MS302 (30 Amp, 2-Pole), MS 303 (30 Amp, 3-Pole), MS402 (40 Amp, 2-Pole) or MS403 (40 Amp, 3-Pole) or equivalent by Cooper Wiring Devices, Hubbell or Pass & Seymour.

## 2.23 DIMMER SWITCHES - DECORA SLIDE TYPE- SPECIFICATION GRADE

- A. Maximum ratings are for continuous full load.
- B. RFI suppression built in.
- C. Extra-heavy use models supplied with matching cover.
- D. Leviton 80800/ 80800-3/ 81000/ 81000-3/ 82000/ 82000-3, 800 watt, 1,000 watt, 2,000 watt - 120V, 277V.
- E. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour (Titan Series), Hubbell, Leviton.
- F. Full on bypass.
- G. Ivory, white, or grey.
- H. Pre-set on-off switch.

## 2.24 SURFACE METAL RACEWAY AND WIREWAY

- A. Provide surface metal raceway system complete with all fittings, wiring, devices, etc. Surface raceway are to have baked enamel finish.
- B. These raceways are permitted only in dry locations where not subject to severe physical damage and must have metal not less than .04" thick. Do not use in hoistways and in any

hazardous classified areas.

- C. The number, type, and size of conductors permitted in raceway are to be clearly marked on raceway or on shipping label.
- D. Splices and taps may be made providing raceway has an accessible removable cover.
- E. Wireway made of 14-gauge sheet metal forming a square trough with hinged cover and complete with couplings, 90° elbows, tees, junction boxes, end plates, and supports may be used for surface wiring at load centers and other locations to the extent permitted by the NEC.
- F. Wireways in sizes 2-1/2" x 2-1/2" up to 12" x 12" square may be used; however, no conductor larger than that which the wireway is designed is to be installed therein. Wireway is to not contain more than 30 current carrying conductors at any cross-section and the sum of cross-sectional areas of all contained conductors at any cross-section is to not exceed 20% of the interior cross-sectional area of wireway.
- G. Wireways are to be treated with rust resistant primer and finished with gray, baked enamel.

#### 2.25 MC CABLE

- A. Type; UL listed Type MC Cable with galvanized steel armor outer casing, color coded circuit conductors, insulated green grounding conductor. Each conductor insulated with thermoplastic insulation.
- B. NEC; Article 330, 518 and to comply with Federal Specification J-C-30B.
- C. Manufacturers: AFC Cable Systems MC, Alean Cable, BICC, Tamaqua Cable.

#### 2.26 FIRE ALARM MC CABLE

- A. Type; UL listed Type MC Cable with galvanized steel armor outer casing, bare grounding conductor, color-coded circuit conductors. Each conductor insulated with thermoplastic insulation.
- B. NEC; Article 760 and to comply with Federal Specification J-C-30B.
- C. Manufacturer: AFC Cable Systems Fire Alarm Cable or approved equal.

#### 2.27 SECURITY PLATES

- A. Receptacle, switch, telephone, and GFI plates in secure areas are to be made of minimum 14-gauge one piece die formed cold rolled steel.
- B. Baked white enamel finish, polyester powder, five-stage pre-treatment, 85% glass, minimum 2H hardness.
- C. Back plate 10-gauge prime galvanized steel with four threaded holes. Security screws Torx T-20.
- D. U.L. Listed.
- E. Manufacturers: Hubbell.

#### 2.28 MULTI SERVICE WALL SOURCE BOX

- A. The new construction box system is to be the WallSource Multi Service Box as manufactured by the Wiremold Company, or approved equivalent.
  1. Four gang box. The box and all system components are to be UL listed in full

- compliance with the standard for 514A and 514C; steel shall be galvanized with a minimum wall thickness of .063" throughout. Backfeed brackets shall be .050" minimum steel with a gray or ivory, suitable for field painting. The device mounting bracket is to be molded from color matching UL approved resins.
2. The box shall include the box, dividers, and mounting brackets. The dimensions of each is to be a minimum of 32 cubic inches per gang and shall be manufactured of 16 gauge minimum thick steel. The box is to accommodate standard power and communication devices.
  3. The box is to have knockouts located on top and bottom, 2-1/4" from the face to accommodate combinations of 1/2"Ø, 3/4"Ø and 1"Ø trade size conduits.
  4. The box is to have a separate ground terminal provided for each gang.
  5. The box is to adjust for a flush installation with the finished wall.
- B. Device Mounting. The self-leveling device mounting bracket is to accommodate standard power devices, Interlink Activate connectivity inserts, and Wiremold 5507 Series faceplates. A mounting bracket designed to accept other manufacturer's devices is to be available. The bracket accommodates up to four power devices or 12 communications inserts. All Wiremold standard faceplates, mounting brackets and trim rings are to be color matched.
- C. Fiber Optic/ Category 5 Radius. The depth of the box shall accommodate a 1-1/4" cable bend radius which meets or exceeds the specifications for fiber Optic and Category 5 cabling and TIA/ EIA - 569A requirements for communications pathways.
- D. Device Covers. Device cover plates in the following configurations are to be available: duplex device cover plates, single 1.40" and 1.59"Ø receptacle cover plates, switch plates, GFCI cover plates, Sentrex surge receptacle cover plates and other rectangular faced plates. Single-gang cover plates are to be of modular design and are to be compatible with wire and cable management systems.
- E. Communication Devices and Accessories. The box manufacturer is to provide a complete line of connectivity outlets and modular multi-media inserts for voice, data, video, audio, etc. with faceplates and bezels to facilitate mounting. A complete line of preprinted station and port identification labels, snap-in icon buttons and write-on station identification labels are to be available.
- F. Support Bracket. A support bracket for mounting on 16" center studs is to be provided on boxes more than two-gang.
- G. Dividers. Dividers are to be removable without any tools.

## 2.29 MULTISERVICE RECESSED WALL BOX (FLAT SCREEN TVs, MONITORS)

- A. Three gang box, plastic housing, white finish. Flush mount appearance allows for snug-to-wall placement of flat-screen TV or monitor.
- B. Surge-protective duplex power outlet and up to 12 multimedia connections.
- C. Position either line voltage or low voltage devices in all three openings.
- D. Low voltage connectors offer both terminated and pull-through capability so plugs, and multimedia connections stay recessed behind the surface of the wall.
- E. Accepts standard TP wall plate.
- F. Legrand TV3WTVSSW. (ACTS standard)
- G. Acceptable Manufacturers: Hubbell, Thomas & Betts.

## 2.30 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Lighting.
  2. Leviton Mfg. Company Inc.
  3. Lithonia Lighting; Acuity Lighting Group, Inc.
  4. Novitas, Inc.
  5. RAB Lighting, Inc.
  6. Sensor Switch, Inc.
  7. TORK.
  8. Watt Stopper (The).
  9. Pass & Seymour
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn luminaires on when covered area is occupied and off when unoccupied; with a time-delay for turning luminaires off, adjustable over a minimum range of one to 15 minutes.
  2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  3. Relay Unit: Dry contacts rated for 20 Amp ballast load at 120- and 277-V AC, for 13 Amp tungsten at 120 V AC, and for 1 HP at 120 V AC. Power supply to sensor shall be 24 VDC, 150 mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2" knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  5. Indicator: LED, to indicate when motion is being detected during testing and normal operation of the sensor.
  6. Bypass Switch: Override the on function in case of sensor failure.
  7. Automatic Light-Level Sensor: Adjustable from 2 - 200 FC; keep luminaires off when selected illuminance level is present.
- C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 0'-6" minimum movement of any portion of a human body that presents a target of not less than 3'-0" square feet.
  2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1,000 square feet when mounted on an 8'-0" high ceiling.
  3. Detection Coverage (Corridor): Detect occupancy within 90'-0" when mounted on a 10'-0" high ceiling.
- D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 1'-0" in either a horizontal or a vertical manner at an approximate speed of 1'-0" per second.
  2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 square feet when mounted on an 8'-0" high ceiling.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1,000 square feet when mounted on an 8'-0" high ceiling.
  4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2,000 square feet when mounted on an 8'-0" high ceiling.
  5. Detection Coverage (Corridor): Detect occupancy anywhere within 90'-0" when mounted on a 10'-0" high ceiling in a corridor not wider than 14'-0".
- E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. A particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 0'-6" minimum movement of any portion of a human body that presents a target of not less than 3'-0" square feet and detect a person of average size and weight moving not less than 1'-0" in either a horizontal or a vertical manner at an approximate speed of 1'-0" per second.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 square feet when mounted on an 8'-0" high ceiling.

### **PART 3 - EXECUTION**

#### **3.01 WIRING DEVICES**

- A. Lighting outlet boxes to have fixture studs – 3/8".
- B. Exterior boxes shall be gasketed and watertight.
- C. Switch and device plates to be mounted with all four corners touching adjacent surface.
- D. All devices to be installed true and plumb.
- E. Switch plates and receptacles shall not be placed back-to-back in adjacent rooms. Offset locations a minimum of 0'-3" to restrict noise transfer. This shall also apply to TV outlets, telephone outlets, data outlets.
- F. All devices on opposite side of a fire resistance rated wall assembly are to be separated by a horizontal distance of not less than 2'-0".
- G. Ground-fault circuit-interrupters are to be provided on all outdoor receptacle circuits, receptacle circuits within toilet and bathrooms, areas in close proximity to water, and wherever else indicated on the drawings or required by Code. While-in-use type covers are to be used in exterior wet locations.
- H. Tamper resistant receptacles are to be installed in day care areas, pediatric health care, psychiatric care as well as where indicated on the drawings. Refer to NEC 406.12 and 517.18 (C).
- I. Arc-fault circuit-interrupters shall be provided on all 15 Amp and 20 Amp receptacle branch circuits in dwelling unit bedrooms.
- J. Dimmer switch devices shall be appropriately sized for derating when a minimum of two or more are ganged together in a common wall box.

#### **3.02 WIRING METHODS**

- A. Exposed interior wiring, panel feeders, home runs, equipment feeders; EMT. EMT conduit shall be securely fastened at intervals not exceeding 10'-0" and within 3'-0" of all boxes. NOTE: Exposed means all wiring which is not installed within walls, above suspended ceilings, or within a pre-manufactured raceway. Any raceway that is to be exposed in a finished area is to be coordinated with the architect/ engineer prior to installation.
- B. Concealed branch circuiting above suspended ceilings, and in stud partitions; MC Cable. MC Cable shall be securely fastened at intervals not exceeding 4'-6", and within 1'-0" of all boxes or fittings. All home runs are to be in EMT.
- C. Wiring in concrete slabs or decks is not permitted unless approved by the architect or structural engineer.
- D. Exposed exterior wiring; Intermediate rigid conduit.
- E. Wiring below concrete slabs in earth; PVC conduit. \* Provide GRS conduit sweep elbow through concrete slab.
- F. Service wiring; PVC conduit encased in 0'-2" of reinforced concrete from utility transformer or pole to the building (below slab is not required to be encased).
- G. Concrete encasement; 0'-2" minimum cover around each conduit requiring encasement. Reinforcement consisting of 4" x 4" No. 4 wire mesh on top level of conduit.
- H. Emergency feeder from generator set (if outside building) to building; PVC conduit encased in 0'-2" of concrete, IMC within building.
- I. Minimum conduit size is 3/4"Ø.
- J. Flexible connections to all motors. Maximum length of flexible conduit is to be 3'-0".

### 3.03 RACEWAY SYSTEMS

- A. All secondary wiring is to be installed in rigid metal conduit, electrical metallic tubing, or MC Cable as specified in these Specifications.
- B. Electrical metallic tubing shall be employed in lieu of rigid metal conduit in all locations except:
  - 1. Underground
  - 2. In gravel, cinder, concrete, or other sub-base floor construction. PVC may be used under floor.
  - 3. Horizontal runs in concrete floor slabs. PVC may be used in slabs.
  - 4. Where subject to possible mechanical injury
  - 5. In masonry construction below finished grade. PVC may be used.
  - 6. Vertically in poured concrete walls.
  - 7. For service work
  - 8. For main distribution feeders
- C. All raceway components shall be fastened at intervals not exceeding 8'-0".
  - 1. Conduits shall not fasten or come in contact with piping of other trades as installed in this building.
  - 2. Conduit is to be separated by a distance not less than 0'-6" from any water, steam or gas lines as may be installed in the building.
- D. Conduits and raceway systems are not to be run concealed in walls, partitions, and floor slabs. Conduit which must be exposed is to be arranged as to not pass in front of windows, doors, access panels, access doors, sky lights, HVAC equipment access for coil removal or filter removal or required service clearances.
- E. Pulling fittings are to be provided for any conduit run which exceeds 200'-0 in length.



- F. All high voltage conduits (all conduit serving equipment over 600-volts) are to be painted red and labeled "HIGH VOLTAGE" on 10'-0" intervals. This does not apply to conduit below grade.
- G. All exposed fire alarm conduits are to be painted red, unless directed otherwise by the architect. This is to include the 120-volt feed to the control panel. Junction boxes are to be labeled "FIRE ALARM."
- H. All emergency circuits (MC Cable and conduit) are to be painted red unless directed otherwise by the architect. Junction boxes are to be labeled "EMERGENCY XXXV." Appropriate voltage is to be indicated.
- I. All conduits and raceway components installed under this Section for completion by others are to be provided with a pull wire affixed at both ends of conduit.
- J. Insulating bushings are to be used on all conduit terminations entering enclosures, boxes, and panels to protect the conductor from damage during installation.

### 3.04 POWER WIRING

- A. Wire between motors, starters, disconnects and source.
- B. Verify proper motor rotation. Check for smooth operation.
- C. Furnish and install weatherproof disconnects, as indicated.
- D. All panel feeders are to be run in EMT raceway system.
- E. All wiring to roof top units, fans, and HVAC units is to be completely installed between panel, disconnect switches and motor or unit connections.
- F. Disconnects are to be mounted adjacent to electrical and mechanical equipment. Indoor installations are to utilize NEMA 1 enclosures. Outdoor installations are to utilize NEMA 3R enclosures.

### 3.05 GROUNDING

- A. All electrical equipment and systems are to be grounded.
- B. Grounding system is to consist of a ground bus bar connected to a driven ground rod. Utilize ground type clamp fitting.
- C. All connections to conduit, equipment and devices are to be made with compression type connections.
- D. The grounding system is to comply with the NEC.
- E. All outside luminaires and poles are to be grounded.
- F. All equipment and devices are to be grounded in accordance with the manufacturer's recommendations.
- G. The ground system is to have a resistance of 25 ohms or less in compliance with the NEC. Utilize the fall of point method.
- H. Furnish a ground system test report at the completion of the work.
- I. Substation area grounding is to be in accordance with local utility company standards.

END OF SECTION

## **SECTION 26 28 16 - SAFETY SWITCHES - GENERAL DUTY**

\* **Residential, light commercial.**

### **PART 1 - GENERAL**

#### 1.01 REFERENCE

- A. Refer to section 26 00 00 for requirements which are applicable to this section.
- B. Refer to NFPA and in particular National Electrical Code.
- C. Refer to NEMA, UL, and IEEE Standards.

#### 1.02 WORK INCLUDED

- A. Provide all labor, material, equipment, and supervision necessary to furnish and install and place into operation safety switches where indicated on the drawings and specified herein.

#### 1.03 SUBMITTALS

- A. Submit manufacturer's shop drawings of devices.

#### 1.04 QUALITY ASSURANCE

- A. Verify that all equipment is installed in accordance with the manufacturer's warranty requirements.
- B. Install systems and equipment in accordance with the National Electrical Code and local codes having jurisdiction.
- C. Provide adequate supervision of labor force to see that installations are correct.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL DUTY SAFETY SWITCHES

- A. APPLICATION DATA
  - 30 Amp-600 Amp
  - 240-volts AC
  - NEMA 1 - General Purpose, painted sheet steel
  - NEMA 3R - Rainproof, painted galvanized steel
  - Standard - Non time delay fuse
  - Maximum - Time delay (dual element) fuse
- B. CONSTRUCTION
  - Visible blades
  - Handle attached to box, not cover
  - Handle position indicates "ON" or "OFF"

- Top hinged cover on NEMA 3R
- Operating mechanism is quick-make, quick-break
- Plated current carrying parts
- Provisions for padlocking the switch in the "OFF" position
- Class R fuse kits for field installation
- C. NEUTRAL AND GROUNDING
  - Provisions for field installation of insulated, groundable neutral
  - Ground kits for field installation
- D. TERMINALS
  - UL listed for Al or Cu wires
  - UL listed for 60°C, or 75°C wires
- E. FUSE CLIPS
  - Spring reinforced
  - Plated
- F. APPLICATION
  - Fusible - Class H or Class R
  - Not fusible
- G. NEMA STANDARDS
  - KS1 - 1975
- H. UL LISTING
  - UL 98 Enclosed Switches
  - Maximum HP ratings
- I. UL LISTED SHORT CIRCUIT RATING:
  - 100,000 rms symmetrical amperes with proper rejection kit and Class R fuses 10,000 rms symmetrical amperes with Class H fuses
- J. Acceptable Manufacturers:
  - 1. Siemens
  - 2. Cutler Hammer
  - 3. ABB Group
  - 4. Square D

### **PART 3 - EXECUTION**

#### **3.01 SAFETY SWITCHES**

- A. Furnish and install safety switches on all motors which do not have integral equipment disconnect devices, local starters and/ or where indicated on the drawings.
- B. Furnish and install fused safety switches where indicated on the drawings.
- C. Safety switches shall be installed to meet the area classification as to standard, hazardous, rainproof, etc.
- D. Safety switches shall be installed securely to building structure or be provided with supplemental support steel such as angle iron or uni-strut when required to locate on other than building structure.
- E. All safety switches shall be grounded.

END OF SECTION

## **SECTION 26 28 17 - SAFETY SWITCHES - HEAVY DUTY**

\* **Industrial, commercial, all 480-volt applications.**

### **PART 1 - GENERAL**

#### 1.01 REFERENCE

- A. Refer to section 26 00 00 for requirements which are applicable to this section.
- B. Refer to NFPA and in particular the National Electrical Code.
- C. Refer to NEMA, UL, and IEEE Standards.

#### 1.02 WORK INCLUDED

- A. Provide all labor, material, equipment, and supervision necessary to furnish and install and place into operation safety switches where indicated on the drawings and specified herein.

#### 1.03 SUBMITTALS

- A. Submit manufacturer's shop drawings of devices.

#### 1.04 QUALITY ASSURANCE

- A. Verify that all equipment is installed in accordance with the manufacturer's warranty requirements.
- B. Install systems and equipment in accordance with the National Electrical Code and local codes having jurisdiction.
- C. Provide adequate supervision of labor force to see that installations are correct.

### **PART 2 - PRODUCTS**

#### 2.01 HEAVY DUTY SAFETY SWITCHES

- A. APPLICATION DATA
  - 1. 30 Amp-1200 Amp
  - 2. 600-volts AC for 480-volt applications
  - 3. 240-volt AC for 240-volt and 208-volt applications.
  - 4. NEMA 1 - General Purpose, painted sheet steel
  - 5. NEMA 3R - Rainproof, painted galvanized steel
  - 6. Maximum - Time delay (dual element) fuse
- B. CONSTRUCTION
  - 1. Visible blades
  - 2. Handle attached to box, not cover
  - 3. Handle position indicates "ON" or "OFF"
  - 4. Top hinged cover on NEMA 3R

5. Operating mechanism is quick-make, quick-break
  6. Plated current carrying parts
  7. Provisions for padlocking the switch in the "OFF" position
  8. Class R fuse standard for 30 Amp-600 Amp switches.
  9. Class L fuses standard for 800Amp-1200 Amp switches.
- C. NEUTRAL AND GROUNDING  
Provisions for field installation of solid neutral assembly.  
Ground kits for field installation
- D. TERMINALS  
UL listed for Al or Cu wires  
UL listed for 60°C, or 75°C wires  
Meets UL 486 B requirements
- E. FUSE CLIPS  
Spring reinforced  
Plated
- F. APPLICATION  
Fusible - Class R or Class L as indicated above  
Not fusible
- G. NEMA STANDARDS  
KS1 - 1975
- H. UL LISTING  
UL 98 Enclosed Switches  
Maximum HP ratings
- I. UL LISTED SHORT CIRCUIT RATING:  
200,000 RMS Symmetrical Amperes with proper rejection kit and Class R fuses.
- J. Acceptable Manufacturers:
  1. Siemens
  2. Cutler Hammer
  3. ABB Group.
  4. Square D

### **PART 3 - EXECUTION**

#### **3.01 SAFETY SWITCHES**

- A. Furnish and install safety switches on all motors which do not have integral equipment disconnect devices, local starters and/ or where indicated on the drawings.
- B. Furnish and install safety switches where indicated on the drawings.
- C. Safety switches shall be installed to meet the area classification as to standard, hazardous, rainproof, etc.
- D. Safety switches shall be installed securely to building structure or be provided with supplemental support steel such as angle iron or uni-strut when required to locate on other than building structure.
- E. All safety switches shall be grounded.

END OF SECTION

## SECTION 26 43 13 - SURGE SUPPRESSION

### PART 1 - GENERAL

#### 1.01 REFERENCE

- A. Refer to Section 26 00 00 for requirements which are applicable to this section.
- B. Refer to National Electrical Code.
- C. Refer to UL, ANSI, IEEE, and NEMA Standards.
- D. Refer to Computer Business Manufacturer's Association (CBEMA), Information Technology Industry Council (ITIC) and International Electrotechnical Commission (IEC) for clamping voltage tolerance guidelines for sensitive equipment.

#### 1.02 WORK INCLUDED

- A. Provide all labor, material, equipment, and supervision necessary to install and place into operation surge suppression where indicated on drawings and/or specifications.

#### 1.03 SUBMITTALS

- A. Submit shop drawings, product data, and manufacturer's installation instructions.
- B. The surge suppression submittal shall also include:
  - 1. Dimensional drawing of each suppressor type indicating mounting arrangements.
  - 2. UL 1449 Third Edition documentation (SCCR, VPR, MCOV, I-n).
- C. All Surge Protective Devices shall be of the same manufacturer.

#### 1.04 QUALITY ASSURANCE

- A. Verify that all equipment is installed in accordance with the manufacturer's warranty requirements.
- B. Install equipment with accordance with National Electrical Code.
- C. Provide adequate supervision of labor force to see that installations are correct.
- D. Surge protection devices shall be manufactured in the USA, by a company normally engaged in the design and manufacture of such devices for at least ten years.

#### 1.05 SAFETY AGENCY APPROVALS

- A. Suppressers shall be listed in accordance with UL 1449 3rd Edition documentation, standard for safety, surge protective devices and meet requirements in UL 1283 for electromagnetic interference filters.

## PART 2 - PRODUCTS

### 2.01 SERVICE ENTRANCE

- A. Surge protection devices shall be installed at all service entrances of each building and/ or as shown on the riser diagram.
- B. Suppressers shall be tested per ANSI/IEEE C62.45.
- C. Wye systems shall have suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground and between the neutral conductor and ground (true 10-mode protection).
- D. Each phase shall have a minimum of two modules. The surge modules shall be fused at a minimum rating of 30 Amp. Modules and fuses shall be field replaceable. Fuses shall be surge suppression fuses. (Ferraz Shawmut VPS Series)
- E. Visible indication of proper suppresser connection and operation shall be provided. The indicator shall consist of an LED array. No single LED or neon indicators will be used.
- F. The surge protection device shall be equipped with an audible alarm that shall actuate when any part of the surge circuitry has been damaged. A silence button shall be provided with the alarm.
- G. The suppressor shall exhibit Sine Wave Tracking circuitry and shall provide high frequency noise filtering up to 50dB attenuation (100 kHz-100 MHz).
- H. Suppressors shall meet or exceed the following criteria:
  - 1. Minimum single impulse current rating (L-N + L-G): 160,000 Amp per phase, 80 kA per mode.
  - 2. Incorporate hybrid circuitry.
  - 3. UL 1449 3rd Edition voltage protection ratings shall not exceed the following:

VOLTAGE	L-N	L-G	N-L	L-L	MCOV
120/208	800	800	800	1200	150
277/480	1200	1200	1200	2000	320

- I. Suppressors shall exhibit redundant protection for each phase and consist of solid-state components and shall operate bi-directionally.
- J. Suppressor shall be equipped with a surge counter with a reset and battery backup.
- K. Suppressor short circuit current rating shall meet or exceed that of the service panelboard.
- L. Total Protection Solutions (Joslyn) Surge Track ST160 or approved equivalent by Advanced Protection Technologies, Inc., Siemens, ABB Group, Eaton, Square D, or LEA International.

### 2.02 SECONDARY DISTRIBUTION INTEGRATED SUPPRESSION PANELS:

- A. Surge Protective Devices shall be installed in secondary distribution panels as shown on the riser diagram.
- B. Suppressor shall be tested per ANSI/IEEE C62.45.
- C. Wye systems shall have suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground and between the neutral conductor and ground (true 10-mode protection).
- D. Visible indication of proper suppressor connection and operation shall be provided.

- E. The surge protective device shall be equipped with an audible alarm that shall actuate when any part of the surge circuitry has been damaged. A silence button shall be provided with the alarm.
- F. The suppressor shall exhibit Sine Wave Tracking circuitry. The surge suppressor shall have suppression circuitry that is field replaceable without disturbing the conduit or enclosure.
- G. Suppressors shall meet or exceed the following criteria:
1. Minimum single impulse current rating (L-N + L-G): 80,000 amperes per phase, 40kA per mode.
  2. UL Clamping voltage shall not exceed the following:
- | VOLTAGE | L-N  | L-G  | N-L  | L-L  | MCOV |
|---------|------|------|------|------|------|
| 120/208 | 800  | 800  | 800  | 1200 | 150  |
| 277/480 | 1200 | 1200 | 1200 | 2000 | 320  |
- H. Suppressors shall consist of solid-state components and operate bi-directionally. The manufacturer of the surge panel shall offer either a surface or flush cover, as required by the job conditions.
- I. Suppressor short circuit current rating shall meet or exceed that of the panelboard.
- J. Total Protection Solutions (Joslyn) Surge Track ST80 or approved equivalent by Advanced Protection Technologies, Inc., LEA International, Siemens, GE, Eaton, or Square D.

### PART 3 - EXECUTION

#### 3.01 SERVICE ENTRANCE

- A. Install one primary suppressor at each utility service entrance. Follow manufacturer's installation instructions.
- B. Suppressor shall be installed on the load side of the service entrance.
- C. Conductors between suppressor and point of attachment shall be at least #6 AWG stranded copper conductor or larger. The conductors shall be kept as short and straight as possible. Lead length of connecting conductors shall be within 3'-0".
- D. Suppressor's ground shall be bonded to the service entrance ground.

#### 3.02 SECONDARY DISTRIBUTION PANELS

- A. Install one secondary suppressor at each distribution panel location or as indicated on the riser diagram. Follow manufacturer's installation instructions.
- B. Suppressor shall be installed on the service panel, per the manufacturer's installation instructions. Contractor shall install circuit breaker in panel to attached surge panel to electrical distribution system if necessary.
- C. Conductors between suppressor and point of attachment shall be at least #6 AWG stranded copper conductor or larger. The conductors shall be kept as short and straight as possible. The maximum length of connecting wiring shall not exceed 1'-6". Pre-wired suppressors with conductors smaller than #6 wire are not acceptable.
- D. Suppressor's ground shall be connected to the distribution panel ground.



### 3.03 CERTIFIED TESTS

- A. The surge suppresser manufacturer shall provide certified test results on the actual product being shipped to the job site. The test results shall be certified by an officer or engineer of the company as being performed on the product after manufacture.
- B. The test conducted shall be per ANSI/IEEE C62.45. The units shall be tested in all modes listed in this specification.

### 3.04 WARRANTY

- A. The surge suppresser shall warrant the surge protective devices and supporting components against defects in material and workmanship for a minimum period of five years.

### 3.05 TESTING

- A. Perform field quality control testing under the supervision of the manufacturer's factory authorized service representative.

### 3.06 DEMONSTRATION

- A. Engage a factory authorized service representative to train owner's personnel to adjust, operate, and maintain equipment.

END OF SECTION

## SECTION 26 50 00 - LIGHTING

### PART 1 - GENERAL

#### 1.01 REFERENCE

- A. Refer to Section 26 00 00 for other requirements of this Section.
- B. All work to conform to the NFPA 70 National Electrical Code.
- C. Provide interior lighting controls to meet the adopted IBC / IECC / ASHRAE 90.1 code. Refer to Specification Section 26 09 00 for additional requirements.
- D. Refer to standards of the Illuminating Engineering Society.
- E. All exit and emergency lighting shall comply with NFPA Life Safety Code 101, ADA, and other local codes as may apply.

#### 1.02 SCOPE

- A. Furnish and install a complete and operating lighting system, including all luminaires, wiring, lamps, and 0-10V dimmable LED drivers.
- B. All lighting outlets shall have a luminaire. If a luminaire designation is missing, furnish and install a luminaire in similar use in the project.
- C. All luminaires shall have a home run. If these are omitted on the drawings the contractor shall allow for a home run to the nearest appropriate panel.
- D. All rooms are to be provided with lighting controls. Provide manual switch and code required control devices as appropriate. If controls are not indicated within a space, controls are to be provided for the space in a similar manner as adjacent or similar spaces.
- E. Provide exit and emergency lighting as required by Code in all spaces to meet requirements of the AHJ. Allow for ten additional luminaires to be installed where directed by the AHJ.

#### 1.03 MOUNTING

- A. The contractor shall be responsible for selecting mounting arrangements of luminaires to suit the construction or ceiling types. Contractor or his agent shall review architectural drawings to establish ceiling types prior to preparing shop drawings for submission. It is NOT to be understood that the luminaire schedule accounts for the mounting types. Frequently ceiling types are changed after the luminaire schedule has been completed.
- B. Luminaires shall be mounted on structurally secure supports. The contractor shall provide miscellaneous steel supports to span between structural elements to provide a base of support for the luminaires at the locations shown on the drawings. Refer to architectural and structural drawings for locations of beams, joists, purlins, etc.
- C. Exterior luminaires shall be mounted with anchor bolts of suitable size secured into concrete bases. The mounting arrangement shall be capable of withstanding a continuous wind of 100 MPH with gales to 130 MPH. EPA of luminaire shall be rated with pole to provide required performance.

#### 1.04 APPROVALS

- A. Furnish shop drawings and catalog cuts of all luminaires for review by the engineer prior to ordering.
- B. Provide samples of any luminaire or luminaires when requested by the owner, architect, or engineer.
- C. Provide a point-by-point lighting level calculation for parking areas, areas when requested by the engineer, and for high profile areas (i.e., main lobbies, atriums, pools, gymnasiums, etc.), when an alternate manufacturer or luminaire is being presented for approval. Calculation shall be provided by the manufacturer or the local manufacturer's representative. Footcandle levels are to be indicated at a maximum of 10'-0" intervals (exterior) or 5'-0" intervals (interior). A drawing is to be provided at the same scale as the contract documents.

## **PART 2 - PRODUCTS**

### **2.01 LUMINAIRE REQUIREMENTS**

- A. Luminaires shall be complete with wiring, lamp holders, lamps, reflectors, glassware, canopies, shades, bases, pendants, etc.
- 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 application.
- C. Luminaires shall be wired with type AF luminaire wire.
- D. Plastic lenses shall not be used. Provide either virgin acrylic, high impact polycarbonate or tempered glass or as specified in the luminaire schedule. Lens thickness shall be a minimum of 1/8".
- E. Any exposed luminaire housing surface, trim frame, door frame and lens frame shall be free of light leaks either between luminaire components or between luminaire and adjacent surface.
- F. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.
- G. Hinged door closure frames shall operate smoothly and easily without binding when installed and latches shall function easily by finger action without the use of tools.
- H. Recessed luminaires installed in an insulated ceiling shall be listed for use in insulated ceilings.
- I. Luminaires in damp areas shall be gasketed, vapor tight, and fabricated with aluminum instead of steel. These luminaires shall have pressure clamping devices in lieu of latches.
- J. Luminaires located in other harsh environments are to be of suitable construction and finish for the intended environment in addition to the requirements listed in the Lighting Luminaire Schedule.
- K. All luminaire lenses shall, from the manufacturer, be shipped within a protective covering, i.e. plastic bag, paper wrapped, to prevent dust, dirt, smudges prior to final acceptance.
- L. Drivers shall be easily serviceable when installed and shall not be mounted to removable reflectors or wire way covers.
- M. Luminaires shall have a minimum CRI of 80 and a CCT of 3500 K.
- N. Luminaires shall have a rated lamp life of 50,000-hours to L70.

- O. Luminaires shall be dimmable from 100% to 10% of maximum output.

## 2.02 LED DRIVERS

- A. Shall be internal.
- B. Shall be designed for ten-year operational life.
- C. Shall be designed to withstand electrostatic discharges according to IEC 61000-4-2.
- D. Shall be furnished with poke-in wire trap connectors, color coded to ANSI standard C82.11.
- E. Shall operate from a line voltage range of 108-305-volts, 50/60 Hz.
- F. Input current shall have Total Harmonic Distortion (THD) of less than 20% with a power factor of >.90% to comply with ANSI standard C82.11
- G. Shall meet UL 8750, UL 1012, and UL 1310 as applicable in NFPA compliant installations.
- H. Shall have no visible output change at  $\pm 10\%$  line voltage input.
- I. Shall have a Class A sound rating (inaudible at 27dBA ambient noise level).
- J. Shall have a universal input voltage (120-277V/ 50-60Hz).
- K. Shall be Underwriters Laboratories (UL) Listed (Class P) and CSA Certified where applicable and rated for use in air handling spaces.
- L. Shall carry a five-year warranty from the date of manufacture for operation at a case temperature of 75°C or less. When operated at a case temperature between 75°C and 85°C, the warranty shall be three years from the date of manufacture.

## 2.03 LED EQUIVILANT LAMPS

- A. LED: ENERGY STAR Certified, NRTL compliant, FM Global compliant. Recessed luminaires shall comply with NEMA LE4, CRI: 80, CCT: 3500 K. Lamps dimmable from 100% to 10% of maximum light output, 50,000-hour lamp rated life, internal driver must be UL Listed, dimmable with any standard dimmer switch, smooth, flicker-free dimming.
- B. Manufacturers; Philips, Feit, Sylvania, GE, Archipelago.
- C. Contractor is to coordinate lamp color for all luminaires. Lamp color is to be similar in all spaces.

## 2.04 EMERGENCY LIGHTING UNITS

- A. General requirements: Self-contained units, thermoplastic enclosure, comply with UL 924. Units include the following features:
  1. Battery: Sealed, maintenance-free, lead-acid type with minimum ten-year nominal life and special warranty, 12-volt, remote capacity as required.
  2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.
  4. Wire Guard: Where indicated, heavy-chrome-plated wire guard arranged to protect lamp heads or luminaires.
  5. Integral Time Delay Relay: Arranged to hold unit on for fixed interval after restoring power after an outage. Provides adequate time delay to permit high-intensity-discharge lamps to restrike and develop adequate output.

6. Test switch and LED pilot light
7. Self-diagnostic circuitry.

B. Manufacturers: Emergi-Lite, Dual-Lite, Chloride

## 2.05 EMERGENCY LED POWER SUPPLY UNIT

- A. Integral Type: Self-contained, modular, battery-inverter unit factory mounted within luminaire body. Comply with UL 924.
1. Test Switch and Light-Emitting Diode Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
  2. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum ten-year nominal life.
  3. Charger: Fully automatic, solid-state, constant-current type.
  4. Operation: Relay automatically energizes lamp from unit when normal supply circuit voltage drops to 80% of nominal voltage or below. When normal voltage is restored, relay disconnects lamp and battery is automatically recharged and floated on charger.
  5. Light output:
    - a. Minimum 1,400 lumens for LED luminaires.

## 2.06 EMERGENCY LIGHTING INVERTER

- A. Remote Type. Self-contained, modular, battery-inverter. Comply with UL 924, NFPA 101, and installed per the National Electrical Code.
- B. The sensing/ transfer equipment shall consist of a transfer relay and solid-state switch. Total transfer from standby to emergency operation shall be accomplished in less than one second after loss or interruption of normal AC power.
- C. The battery charger shall include a ferro resonant transformer and a full wave rectifier. It shall be of solid-state construction and shall provide three rates of charge. The charger shall incorporate a digital, solid-state timer which periodically allows an automatic equalizing charge to be applied to the batteries.
- D. The solid-state DC-to-AC inverter shall have a ferro resonant output transformer which provides 120-volt, or 277-volt +/- 5% of single phase, 60Hz +/- 1Hz emergency power. The design shall yield a sinusoidal output waveform with maximum 10% Total Harmonic Distortion. Efficiency shall be not less than 75%.
- E. Designed system protection shall include a Low Voltage Battery Disconnect feature, short-circuit protection, current-limiting feature, and overload protection of 130%.
- F. Batteries shall be lead-calcium.
- G. Supervisory instrumentation and controls shall include, but not be limited to, battery DC voltmeter, output AC voltmeter, AC utility power "on" light, emergency power "on" light, system test switch to simulate normal AC power failure, high charge indicator light and charge current ammeter.
- H. The entire system shall be enclosed in a heavy-gauge, commercial-grade steel cabinet, enamel-finished in beige hammer tone and including hinged, lockable doors. The cabinet shall be free-standing or wall-mounted, and batteries shall be positioned below the modular electronics for easy maintenance.
- I. Manufacturers; IOTA, DUAL LITE, Bodine, Emergi-Lite/ ABB, or equal.

## 2.07 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction. Refer to Luminaire Schedule on drawings.
- B. Internally lighted Signs:
  - 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
  - 2. Self-Powered Exit Signs (Battery Type) Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80% of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    - f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

### **PART 3 - EXECUTION**

#### **3.01 LUMINAIRES**

- A. All recessed LED troffers (2' x 2', 2' x 4', and 1' x 4') and recessed luminaires weighing up to 20 lbs. are to be installed in grids with mounting clips and with grid secured at diagonal corners of luminaire to the building structure. (4' x 4') luminaires to be secured at four corners.
- B. Recessed luminaires between 20 and 50 pounds are to have, in addition to above, 12-gauge steel safety chains at opposite corners hung slack from the building structure. Luminaires above 50 pounds to be independently supported directly from the structure with approved hangers and angular sway bracing according to manufacturer's installation guidelines.
- C. Surface mounted and pendant luminaires under 15 pounds can be supported directly from the outlet box when all of the following apply: screws pass through round holes and not key slots in the luminaire body, the outlet box is attached to a main ceiling runner, and the outlet box is supported vertically from the building structure.
- D. Surface luminaires between 15 and 50 pounds shall be bolted to the ceiling independent of the outlet box. Luminaires over 50 pounds shall be secured to the building structure using a manufacturer's approved mounting method.
- E. Luminaires to be set plumb.
- F. Provide 6'-0" flexible leads on recessed luminaires to allow for easy removal.
- G. Recessed luminaires shall be set with mounting frames.
- H. Coordinate final location of all luminaires with other disciplines to avoid interferences and

potential obstructions as the work progresses.

- I. Luminaires used for temporary lighting during construction shall be removed, cleaned, and re-installed prior to acceptance of the lighting system.
- J. Luminaires shall be cleaned and free of all dirt, dust, smudges, and surface imperfections just prior to final acceptance.
- K. Luminaires which are recessed in a fire rated ceiling shall be provided with an enclosure around the luminaire which shall maintain the fire rating integrity of the ceiling system. The installation of the enclosure shall meet the requirements of the authority having jurisdiction. The luminaire shall be insulation rated for higher temperature operation.
- L. All recessed or surface mounted luminaires on or in sloped ceilings shall have sloped ceiling adapters to allow for vertical light distribution.

### 3.02 SWITCHING

- A. Provide lighting control switch legs to wall switches for all luminaires except for those operated by integral switches.
- B. Provide 3-way or 4-way control where indicated and for rooms with more than one entrance.
- C. Provide a single time clock, contactors and relays as indicated on the drawings and as necessary for site lighting and parking lot lighting control.
- D. Provide interior lighting controls to meet IBC 2015/IECC 2015/ ASHRAE 90.1. Refer to Specification Section 26 09 00 for additional requirements.

END OF SECTION

## SECTION 270100 - OPERATION AND MAINTENANCE OF COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. This section is inclusive to all Division 27 sections.

#### 1.2 DRAWINGS

- A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.
- B. All work shall be subject to the Owner's direction and approval.

#### 1.3 SUMMARY

- A. This project consists of providing a complete structured cabling system for the Campbell Library building at Rowan University. The structured cabling system includes voice and data cabling locations as shown on the drawings for this building. This building will be connected to the campus network via fiber cables.
- B. The scope of work includes:
  - 1. Provide all voice and data throughout as a total end-to-end solution as described within the division 27 documents and as shown on the "T" series drawing sheets.
    - a. Provide the necessary parts and supplies whether specifically mentioned or not to turn over to the Owner a complete system.

#### 1.4 QUALITY ASSURANCE

- A. In addition to procedures stated in Division 1:
  - 1. Cutting and Patching
    - a. Perform required cutting, drilling, and chasing to receive new equipment. In general, perform all patching and repairing necessary to restore to original condition, all surfaces that may become damaged during the installation. All work shall be executed by persons normally employed in the type of work to which they are assigned.
    - b. Paint all structural steel and all steel parts used for hangers and for supporting conduits, junction boxes and technology equipment with one (1) coat of "red" oxide primer before erection. After steel is in place, paint again with a minimum of one (1) coat of paint, color as directed by the Architect.
    - c. The Contractor is responsible for all cutting, patching, plastering, and painting associated with the new installation.
  - 2. Clean Up



- a. The jobsite shall be cleaned at the end of each day.
  - b. Upon completion of the contract, remove all workmen's appurtenances from the premises. Clean the premises of all debris caused by the work and leave the installation clean and in first-class operating condition.
3. Storage of Material and Equipment
- a. Store materials and equipment in a location approved by the Owner.
  - b. Be responsible for securing all equipment and materials employed in the installation until final acceptance by the Owner. The Owner will not be responsible for loss reimbursement to the Contractor.
  - c. Be responsible for the replacement of all damaged or defective work, materials, or equipment. Do not install sensitive or delicate equipment until major construction work is completed. Ensure that equipment is protected from all construction site activities.
  - d. Observe and conform to all applicable safety regulations required by the Owner and OSHA.

## 1.5 INTERPRETATION AND CONFLICTS

- A. Bring any discrepancies determined or omissions found lacking in the Contract Documents to the Technology Consultant's attention before submitting the bid. After award of Contract, the Owner or Technology Consultant will make the interpretation of any conflict.
- B. The failure to question any controversial item will constitute acceptance by the Bidder who shall execute it to the satisfaction of the Owner after being awarded the Contract.
- C. If mention has been omitted pertaining to details, items or related accessories required for the completion of any system, it is understood such item and accessories are included in the Contract. After the Contract is awarded, claims based on insufficient data or incorrectly assumed conditions, or claims based on misunderstanding the nature of the work, will not be recognized.
- D. The General Conditions, Requirements, and Special Provisions, of any larger body of specifications, of which this Specification may be a part, are hereby made a part of this Specification. In the event that any clauses or provisions of the larger body of specification conflict with the letter or intent of this Specification, the Contractor shall immediately notify the Architect and the Technology Consultant for clarification and direction.
- E. All work shown shall be new work provided under this Contract except that work labeled "present to remain" and that equipment labeled "to be furnished by others but installed by the Contractor."

## 1.6 LABELING AND IDENTIFICATION

- A. Clearly Label all new equipment, devices, and miscellaneous apparatus for easy identification and for safety.
- B. Owner will identify and provide labeling schemes for all patch panels, wall plate end point locations, 110 blocks, fiber termination cabinets, and backbone cables according to Owner's standards.

## 1.7 LOCATION OF EQUIPMENT AND RACEWAY

- A. The drawings are diagrammatic and indicate the general arrangement of equipment to be installed.

- B. Coordinate the structural, electrical/electronic, and finished conditions of work accordingly.
- C. Coordinated locations of all equipment, raceways, junction boxes, cable runs, conduit runs, etc., shall be determined at the site. Install all items to accommodate the various conditions in the building and make deviations necessary without additional cost.

#### 1.8 WIRING METHODS

- A. Install all wire and cable located in finished areas in new or existing raceways as indicated on Drawings.
- B. Install new raceways in the locations shown on the drawings and as specified.

#### 1.9 ORDINANCES AND CODES

- A. Nothing contained in the Specifications or shown on the drawings shall be construed as to conflict with any local, municipal or state laws and regulations, governing the installation or other contract work, and all such ordinances and regulations, including the latest: National Electric Code, TIA standards and the National Electric Safety Code, are hereby incorporated and made a part of these Specifications, and shall be satisfied by the Contractor at no additional expense to the Owner.
- B. Secure all permits and inspection certificates for submission to the Owner.

#### 1.10 SYSTEM CONTINUITY

- A. Reconnect all existing items that remain in use. Provide all materials and labor required to retain continuity of existing circuits or systems that are disrupted by these alterations even though not indicated on the drawings.

#### 1.11 SUBMITTALS

- A. Shop drawings shall be checked, corrected, and approved by the Contractor before being submitted to the Owner/Technology Consultant for review. Before submitting shop drawings, the Contractor shall carefully examine them and shall certify by his stamp/signature that, to the best of his knowledge, they comply with the Contract Documents. The Contractor must receive written approval from the Owner or an authorized representative of the Owner, in writing, prior to fabricating or installing any materials. Approval will be given based upon shop drawings. The shop drawings shall indicate complete details of work to be performed. Drawings shall include a title block naming the Project, Architect, Technology Consultant, Contractor, drawing title, drawing number, revision number if applicable and date. Submit all Shop Drawings complete as a single submission. Isolated items will not be accepted, except with prior approval.
- B. Where the shop drawings deviate from the requirements of the Contract documents, the Contractor shall (1) correct the shop drawings as required, or (2) where the deviations do not necessarily require correction, notify the Owner/Technology Consultant of the deviations.
- C. Submit to the Architect four (4) sets of shop drawings or otherwise documents/equipment for the following equipment and obtain written approval before ordering materials. See the drawings and scope information for applicability of product to phase and project.

- D. The Contractor shall provide product submittals for all system components as defined in Part 2 of all associated communication specification sections related to this project. These components shall include:
1. Patch Panels (UTP and Fiber)
  2. Cables (UTP and Fiber)
  3. Patch Cables (UTP and Fiber)
  4. Faceplates and Jacks
  5. Proposed Labeling Scheme
  6. Cable Management Devices
  7. Innerduct
  8. Punch Down Blocks
  9. Protection Devices
  10. Grounding and Bonding Equipment
  11. Racks and Cabinets
  12. Nameplates and Identification Devices
  13. Basket Style Cable Tray
  14. Ladder Style Cable Tray
  15. Hangers and Supports
  16. Strain Relief Products
  17. All other equipment identified or inferred as may be required by the Architect, Technology Consultant or Owner.
- E. Submit complete submittal list for Architect/Technology Consultant review prior to purchasing any equipment.
- F. Where multiple products are shown on one cut sheet, circle product to be used.
- G. The selected Contractor will allow sufficient time in project scheduling for client and review by the Architect's Technology Consultant.
- H. In some cases, manufacturer warranty may call for the review of system documentation to assure that the system design meets manufacturer warranty requirements. In such instance, with prior approval of the Owner, the Contractor shall provide a complete set of Project Documents and product data to the system manufacturer for review. The system manufacturer shall review the complete system package and provide documentation attesting to the system compliance with manufacturer warranty requirements. This documentation shall be included with the Contractor Shop Drawings submittal. The Technology Consultant will not review the Contractor Shop Drawings submittal, which does not include the manufacturer warranty compliance review documentation.
- I. Isolated items will not be accepted, except with prior approval.
- J. Each shop drawing shall contain reference to the applicable drawing and specification section and verification of compatibility with the systems involved.
- K. All nameplate data shall be submitted with equipment submittals – refer to other sections for complete identification requirements.
- L. Shop drawings shall show conformance with specified performance characteristics, or the Contractor shall assume responsibility for all deviations including all additional costs as a result of the deviations.

#### 1.12 STANDARDS OF MATERIAL AND WORKMANSHIP

- A. All work shall be executed by persons skilled in the work to which they are assigned. This shall include all copper and fiber connections including testing, and all plastering and painting.
- B. All materials and equipment in the work shall be new and of first quality, produced by manufacturers of recognized reputation for each line of material and equipment. The fact that materials or equipment offered have been recently developed or are untried may be sufficient justification for their rejection.

#### 1.13 PROTECTION OF WORK AND EQUIPMENT

- A. This Contractor shall use the required safety precautions, methods, and skills to prevent possible unsafe conditions or conditions unduly susceptible to fire.
- B. When this Contractor is working in areas in which the building occupants have access, Contractor shall provide suitable barriers around his operation.
- C. This Contractor is responsible for containing the undue spread of vapors or odors from his work area.

#### 1.14 TESTS AND INSTRUCTIONS

- A. Upon completion of the work, and upon the request of the Architect, the Contractor shall be prepared to test all systems in the presence of the Owner, Architect, or Technology Consultant. Such testing shall occur at a time that is mutually acceptable to all parties. The Contractor's representatives assisting in the performance of these tests shall be thoroughly familiar with the details of the system and shall include the field supervisor responsible for installing the system.
- B. The Contractor will provide the Owner with all manufacturers' systems certifications within 60 days of completion of work. Contractor's final retention payment will not be released until all manufacturers' system certifications have been received and reviewed by the Architects Technology Consultant.
- C. Correct all failures or improper conditions.
- D. Demonstrate to the Owner the proper care and maintenance of all new items.

#### 1.15 GUARANTEE

- A. Unless stated otherwise in Division 1:
  - 1. The Contractor and his surety shall guarantee in writing for a minimum period of one (1) year from the date of final acceptance that all materials, equipment, and labor furnished by Contractor are free from defects.
    - a. Refer to cable system warranty for additional requirements.
  - 2. The Contractor shall further guarantee that if any piece of material or equipment is found to be defective within the guarantee period because of faulty manufacture or faulty installation, in the opinion of the Owner, Contractor will replace and install and test such material or equipment without any further expense to the Owner.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

## SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.
- B. This section is inclusive to all Division 27 sections.

#### 1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for the structured cabling system and campus inter-building distribution systems. It includes Contractor qualifications, terminations, and testing parameters. Reference individual sections for further expansion of these requirements.
- B. Permits, Inspections, Codes and Regulatory References
  - 1. General: Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract and shall submit approval certificates to the Technology Consultant.
  - 2. Codes: The cabling system installation shall comply fully with all local, county and state laws, ordinances, and regulations applicable to electronic and electrical installations.
  - 3. The following industry standards are the basis for the structured cabling system described in this document:
    - a. TIA-568.1-D Commercial Building Telecommunications Cabling Standard
    - b. TIA-568.2-D Balanced Twisted Pair Cabling Components Standard
    - c. TIA-568.3-D Optical Fiber Cabling Components Standard
    - d. TIA-568.4-D Broadband Coaxial Cabling and Components Standard
    - e. TIA-569-E Commercial Building Standard for Telecommunications Pathways
    - f. TIA-606-D Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
    - g. TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
    - h. NFPA National Fire Protection Association
    - i. NFPA 70 National Electric Code (NEC)
    - j. ISO/IEC International Organization of Standards/International Electrotechnical Commission
    - k. ISO 11801-1 Generic Cabling Requirements for Twisted Pair and Optical Fiber Cables
- C. If there is a conflict between applicable documents, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

- D. This document does not replace any code, either partially or wholly. The Contractor must be aware of local codes that may impact this project.

### 1.3 ABBREVIATIONS AND DEFINITIONS

- A. General: In addition to abbreviations defined in Division 1, utilize the following abbreviations and definitions for discernment with the Drawings and Specifications.

B. Abbreviations:

1. ANSI American National Standards Institute
2. ASA American Standards Association
3. ASTM American Society of Testing Materials
4. AVC Audiovisual Contractor
5. EC Electrical Contractor
6. ETL Electrical Testing Laboratories, Inc.
7. GC General Contractor
8. ICEA International Cable Engineers Association
9. ICIA International Communications Industries Association
10. IEEE Institute of Electrical and Electronics Engineers
11. NEC National Electric Code
12. NEMA National Electrical Manufacturers Association
13. NFPA National Fire Protection Association
14. NIC Not In Contract
15. NRTL Nationally Recognized Testing Laboratory
16. O Owner
17. OEM Original Equipment Manufacturers
18. OSHA Occupational Safety and Health Administration
19. OSP Outside Plant
20. SCC Structured Cable Contractor
21. TC Technology Consultant
22. TIA Telecommunications Industry Association
23. UL Underwriter's Laboratories, Inc.

C. Definitions:

1. ACCEPTED means as accepted by the Technology Consultant or his representative.
2. APPROVED means as approved by the Technology Consultant or his representative.
3. ARCHITECT means Kimmel Bogrette or their designated representative.
4. AS DIRECTED means as directed by the Technology Consultant or his representative.
5. AS REQUIRED means as required by some other part of the contract documents which may include reference specifications or manufacturer's recommended practice.
6. AS SHOWN means as shown on the drawings, shop drawings or other graphical elements of the contract documents.
7. BIDDER is used to indicate that entity generating the bid response.
8. CONCEALED means embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings.
9. CONDUIT means the inclusion of all fittings, hangers, supports, sleeves, etc.
10. CONTRACTOR is used to indicate the successful Bidder to whom the Owner has awarded the contract.
11. EQUAL means equivalent as approved by the Technology Consultant or his representative.
12. FURNISH means to indicate the responsibility to ship or deliver the item to the job site, freight prepaid, for receipt, staging and installation by others.

13. INSTALL means to join, unite, fasten, link, attach, setup or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular work referred to. It is also used to indicate the responsibility of receiving the item at the job site, providing adequate storage, unpacking, or uncrating the item, physically securing the item, or otherwise making ready the item for its intended use by following the instructions and approved methods of the manufacturer and those contained herein.
14. OWNER or CLIENT means Rowan University or their designated representative.
15. OWNER FURNISHED CONTRACTOR INSTALLED (OFCI) shall refer to equipment that will be furnished by the Owner for installation by the Contractor. The Contractor shall be responsible for installing and integrating this equipment as detailed herein.
16. PROVIDE means to furnish, install, place, erect, connect, test, and turn over to Owner complete and ready for the regular operation, the particular work referred to.
17. PROVIDED BY OTHERS shall refer to material and work which is related to this contract but has been provided by parties other than the Contractor.
18. SPECIFICATION is defined as the body of documentation provided to the Contractor with the Request for Quotation, as well as all addenda to said documentation. Throughout this document, words such as “herein” refer to the entire Specification, and not just this written document. The Specification includes, but is not limited to, this written specification document, all drawings, as listed in the List of Drawings, cable terminations and labeling schedule, additions and/or modifications as detailed in written addenda, additions and/or modifications as detailed in drawing additions or reissues.
19. TECHNOLOGY CONSULTANT refers to NV5 Technology and Acoustics, 32 Old Slip, Suite 401, New York, NY 10005 NV5Address.
20. The term SHALL is mandatory; the term WILL is informative; and the term SHOULD is advisory.
21. WIRING means the inclusion of all raceways, fittings, conductors, connectors, patch panels, labeling, junction and outlet boxes, connections, testing, and all other items necessary and/or required in connection with such work.

- D. For the purpose of Division 27, in the event of conflict with an abbreviation or definition in Division 1 and in Division 27, the Division 27 abbreviation or definition shall prevail.

#### 1.4 PERMITS, CODES, STANDARDS, AND INSPECTIONS

- A. Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract and shall submit approval certificates to the Technology Consultant.
- B. The installation shall comply fully with all local, county and state laws, ordinances, and regulations applicable to electronic and electrical installations.
- C. Unless stated in Division 1, the installation shall be in compliance with the requirements of the latest revisions of:
  1. All approved published instructions set forth by equipment manufacturers.
  2. All local codes and ordinances in effect and having jurisdiction.
  3. Americans with Disabilities Act (ADA)
  4. All requirements of electric and telephone utility companies
  5. BICSI Telecommunications Distribution Methods Manual (latest edition)
  6. International Building Code (IBC)
  7. Institute of Electrical and Electronic Engineers (IEEE)
  8. National Board of Fire Underwriter’s (NBFU)
  9. National Electric Code (NEC)
  10. National Electrical Manufacturer’s Association (NEMA)
  11. National Electric Safety Code (NESC)



12. Occupational Safety and Health Act (OSHA)
13. Telecommunications Industry Association (TIA)

- D. Submit certificates issued by approved authorized agencies to indicate conformance of all work with the above requirements, as well as any additional certificates as may be required for the performance of this contract work.
- E. Should any change in drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify the Technology Consultant prior to execution of the work. The work shall be carried out according to the requirements of such code in accordance with the instructions of the Architect and the Technology Consultant at no additional cost to the Owner.

## 1.5 CONTRACTOR QUALIFICATIONS

- A. All bidders shall demonstrate their qualifications by providing the following documents:
1. A list of the LAST five (5) Structured Cabling systems that were installed by the bidder:
  2. The listing shall include only systems that included the installation of fiber optic cable and Category 5e, 6, or 6A twisted pair.
  3. The listings shall be for the last five (5) projects that are completed and have been turned over to the Owner.
  4. The listing shall include a brief description of the project, size of the system, products used, Owner's name, phone number, address, and representative, date started, and date of completion.
- B. The bidder shall furnish a list of all test equipment that will be used in the installation and testing of the fiber optics, multi pair copper distribution and UTP cable.
- C. Performance testing of CAT6A cable will be completed using a Fluke DSX2-5000 Cable Analyzer. Performance testing of fiber optic cable will be completed using an OTDR. Proof of valid and current test equipment calibration and firmware must be provided to Owner 30 days prior to testing.
- D. The bidder shall furnish a listing of the names of full-time employees that will work on the project and list their training and certification in the installations and testing of structured cabling. At all times through the duration of the project a minimum of 50% of the on-site cabling personnel, including the project lead, will be BICSI Certified Installers (ITS Installer 1). Submit the BICSI Installer Certificates with bid.
- E. The bidder shall have a Registered Communication Distribution Designer (RCDD) with five (5) years of experience, on staff. Submit the RCDD Certificate and project information with bid.
- F. All of the above documents shall be submitted along with the Bid Form, by the Bid due date.
- G. The Contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data and voice network systems. The Contractor shall at a minimum possess the following qualifications:
1. Those licenses/permits required to perform telecommunications installations in the specified jurisdiction.
  2. Personnel trained and certified in the design of the Siemon Cabling System. Submit the Cabling System Design Certificates with bid.
  3. Personnel trained and certified to install the Siemon Cabling System. Submit the Cabling System Installation Certificates with bid.

- H. Personnel must be knowledgeable in local, state, and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall apply.
- I. The Contractor shall have been in the business of installing structured cabling systems for a minimum of five (5) years.
- J. The Contractor must possess and maintain current liability insurance certificates.

## 1.6 WARRANTIES

- A. Provide complete written warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.
- B. Warranty and Certification of the Cabling systems and connectors:
- C. The Contractor shall provide a minimum 30 Years performance and product warranty that installation, cable, connectors and connecting hardware shall be free from defects in material, workmanship, and fabrication. Submit detailed warranty documentation with close out documentation.
- D. The system shall be certified by the cable/connector manufacturer and warranted for the specified performance for minimum of 30 Years. The Contractor shall conform to the manufacturer's certification including submittals of all required documentation to the manufacturer.
- E. The Contractor shall obtain, from the manufacturer, a Registration Document and Certificate for the specific installation issued in the Owner's name. Upon receipt of the Registration Document and Certificate, the Contractor shall forward a copy to the Technology Consultant and deliver the original to the Owner.
- F. Any material, equipment, or appurtenance whose operation or performance does not comply with the requirements of the Contract or any equipment which is damaged prior to acceptance will be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

## 1.7 SUBMITTALS

- A. The Contractor shall provide product submittals for all system components. These components shall include all cable, termination devices, splice connectors, patch panels, associated racks and enclosures, patch cords and labeling devices. The selected Contractor will allow sufficient time in project scheduling for client and review by the Architect's Technology Consultant.
- B. Where multiple products are shown on one cut sheet, circle product to be used.

## 1.8 PROJECT DRAWINGS AND SPECIFICATIONS

- A. The Contractor shall carefully examine the Drawings and Specifications of all trades and report discrepancies to the Technology Consultant in writing to obtain corrective action. No departures from the Contract Documents will be made without prior written approval from the Technology Consultant.

- B. Questions or disputes regarding the intent or meaning of Contract Documents shall be resolved by the interpretation of the Technology Consultant. The Architects' interpretation is final and binding.
- C. The Drawings and Specifications are not intended to define all details, finish materials, and special construction, which may be required or necessary. The Contractor shall provide all installations complete and adequate as implied by the project documents.
- D. Drawings are diagrammatic only and do not show exact routes and locations of equipment and associated wiring. The Contractor shall verify the work of all other trades and shall arrange his work to avoid conflicts. In the event of a conflict, the Contractor shall obtain corrective action from the Technology Consultant.
- E. If there is a conflict between contract documents, the document highest in precedence shall control. The precedence shall be: first; permits from agencies as required by law, second; special provisions, third; specifications, fourth; drawings, fifth; reference specifications and sixth; vendor submittals.

#### 1.9 COOPERATION AND COORDINATION WITH OTHER TRADES

- A. The Structured Cabling Contractor shall be responsible for all cross connecting and coordination with vendors and other trades to provide a complete operational system.

#### 1.10 PRODUCT LISTING

- A. When two or more items of the same material or equipment are required, they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, conduit, fittings, sheet metal, solder, fasteners, and similar items, except as otherwise indicated.
- B. Provide products that are compatible within systems and other connected items.
- C. All powered equipment shall be UL listed and follow approval criteria defined by the local authority having jurisdiction.

#### 1.11 RECORD DRAWINGS

- A. When all work has been completed and before final acceptance, the Contractor shall furnish to the Technology Consultant and Owner a complete set of documents that clearly represent all contract work "as built." This shall be inclusive of all test results and drawings. The Contractor is responsible for assuring the accuracy of the As-Built documentation.
- B. As part of the completed "As-Built" document package the Contractor will deliver a final cable plant matrix (in spreadsheet format) of CAT6A outlets and floor plan with reference numbers. Final "As-Built" drawings will be delivered in an acceptable format.

#### 1.12 MAINTENANCE MANUALS

- A. Prepare maintenance manuals (Record Document) in accordance with the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's data of each piece of equipment.

#### 1.13 GENERAL WARRANTIES

- A. Provide complete warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.
- B. Any material, equipment, or appurtenance whose operation or performance does not comply with the requirements of the Contract Documents or which are damaged prior to acceptance will be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. Major items of equipment shall have manufacturer's name, address and catalog number on a plate securely attached. All equipment or apparatus of any one system must be the product of one manufacturer or approved equivalent products of a number of manufacturer's that are suitable for use in a unified system.
- B. All materials and equipment for which Underwriter's Laboratories have established standards shall bear a UL label of approval.
- C. Where proprietary names are used, whether or not followed by the words "or as approved," they shall be subject to substitution only as approved by the Architect, Technology Consultant, and Owner.
- D. Where the Contractor proposes substitute equipment, Contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size, and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

### PART 3 - EXECUTION

#### 3.1 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project identified with names, model numbers, types, grades, compliance labels, and other information needed for distinct identification; adequately packaged and protected to prevent damage during shipment, storage, and handling.

### 3.2 INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of systems, materials, and equipment.
- B. Coordinate systems, equipment, and materials installation with other building components.
- C. Verify all dimensions by field measurements.
- D. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for cabling installations.
- E. Sequence, coordinate, and integrate installations of cabling materials and equipment for efficient flow of the Work.
- F. Install systems, materials, and equipment level and plumb, parallel, and perpendicular to other building systems and components.
- G. Coordinate the cutting and patching of building components to accommodate installation of cabling equipment and materials.
- H. Coordinate the installation of all materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.
- I. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.
- J. Plywood on MDF/IDF walls shall be void-free fire-resistant grade AC grade or better with a minimum thickness of 0.75 inches with two coats of fire-resistant paint on all useable walls. Use flush hardware and supports to mount plywood. Ensure that the strength and placement of the hardware are sufficient to handle the total anticipated load and mounting of cabling components.
- K. Ensure that the fire rating of all walls and floors is maintained. Plywood backboard sheets will have the fire-rated stamp left visible for inspection.

### 3.3 CONDUIT AND RACEWAY

- A. Actual locations of all equipment, raceways, junction boxes, cable runs, conduit runs, etc., shall be determined at the site.
- B. Provide a pull box or pull point immediately before and after any conduit or raceway section containing two ninety-degree bends, or any single run exceeding fifty feet in length. Pull box openings must face in the direction from which personnel will approach and must have a minimum eight inches in front of and to all sides of the opening. Pull boxes shall not be used in place of a bend. Conduits must always exit the pull box from the opposite side it entered (no change of direction inside the pull box will be accepted).
- C. Carefully investigate the structural, electrical/electronic, and finished conditions of work accordingly.

### 3.4 CABLE PROTECTION

- A. Cables shall not be exposed to paint, paint remover, water, or any liquids which may degrade the performance of the cable, void the manufacturer's warranty, alter the flame and/or smoke characteristics of the cable, or obscure the flame rating designations printed on the jacket. Cables exposed to paint, paint remover, water, or any liquid shall be replaced by the Contractor.

### 3.5 FIRESTOPPING

- A. General
  - 1. Provide through penetration fire stop systems to prevent the spread of fire through openings made in fire-rated walls or floors to accommodate penetrating items such as conduit, cables, and cable tray. Fire stop shall restore floor and wall to the original fire rated integrity and shall be waterproof. The fire stop systems and products shall have been tested in accordance with the procedures of U.L. and material shall be U.L. classified as materials for use in through-penetration fire stops.
  - 2. The fire stop system shall comply with the NEC and with NFPA 101-Life Safety Code (latest edition) and shall be made available for inspection by the local inspection authorities prior to cable system acceptance. The Contractor shall be responsible for verifying the fire rating of all walls and floors having cabling penetrations. Coordinate sealant installation with work of other trades and with the general Contractor on site.
  - 3. Fire stop systems shall be UL Classified to ASTM E814 (UL 1479) or shall be approved by a qualified Professional Engineer (PE), licensed in the state of New Jersey.
  - 4. A drawing showing the proposed fire stop system shall be provided to the Owner and Technology Consultant prior to installing the fire stop system(s).

### 3.6 GROUNDING AND BONDING

- A. Ground communications systems and equipment in accordance with the TIA-607-D Grounding Standard and NEC requirements except where the Drawings or Specifications exceed NEC requirements. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, paging equipment, CATV equipment etc. entering or residing in technology spaces shall be grounded to the respective ground system using a minimum #6 AWG solid copper bonding conductor and compression connectors. All wires used for technology grounding purposes shall be identified with green insulated wires. All cables and bus bars shall be identified and labeled in accordance with the Technology Identification requirements.

### 3.7 TESTING

- A. Contractor, at his own expense, shall make any tests directed by an inspection authority or by the Technology Consultant and shall provide all equipment, instruments, and materials to make such tests.
- B. Upon completion of work, all component parts, both singularly and as a whole, shall be set, calibrated, adjusted, and left in satisfactory operation condition to suit load conditions, by means of instruments furnished by the Contractor.
- C. Notify the Owner and Technology Consultant seven (7) days prior to the testing dates. Upon completion of a test, a statement of certification shall be forwarded to the Technology Consultant for his approval.

## SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.
- B. Drawings and general provisions including Division 1, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes:
  - 1. Commercial building grounding and bonding requirements for telecommunication infrastructure.
  - 2. Requirements for bonding and communications cabling, equipment, pathways, spaces, and mounting equipment.
  - 3. Basic requirements for grounding for protection of life, equipment circuits and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.
- B. Comply with the TIA-607-D, "Grounding and Bonding Requirements" and the NEC.

#### 1.3 RELATED SECTIONS:

- A. Section 013300 – Submittal Procedures.
- B. Section 260526 – Grounding and Bonding for Electrical System.
- C. Section 270100 – Operation and Maintenance of Communications Systems
- D. Section 270529 - Hangers and Supports for Communications Systems

#### 1.4 REFERENCES

- A. ANSI/NFPA-70, 2011 National Electrical Code (NEC)
- B. ANSI/IEEE Std. 1100-2005, Recommended Practice for Powering and Grounding Electronic Equipment
- C. ANSI/IEEE Std. C2, 2007 National Electrical Safety Code (NESC)
- D. TIA-607-D Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises
- E. ANSI/TIA-606-D Administration Standard for Telecommunications Infrastructure

- F. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
- G. OSHA Standards and Regulations - all applicable
- H. Local Codes and Standards - all applicable
- I. Anywhere low-voltage cabling Standards conflict with electrical or safety Codes, Contractor shall defer to NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either. Knowledge and execution of applicable codes is the sole responsibility of the Contractor. Any code violations committed at the time of installation shall be remedied at the Contractor's expense. Contractor is responsible to bring any perceived conflicts between project documents and referenced Standards or Codes to the attention of the Architect and Technology Consultant for resolution.

#### 1.5 SYSTEM DESCRIPTION

- A. Provide a communications bonding and grounding system as described in this document and project drawings and in compliance with the above cited Codes, Standards and Agencies.
- B. Comply with the requirement of Code of Practice for Info-Communications Facilities in Buildings.
- C. Comply with the requirement for Section 260526 - Grounding and Bonding for Electrical System.
- D. Bond the following items within the telecommunications grounding system.
  - 1. All communications system active equipment.
  - 2. All PDU and surge protection equipment.
  - 3. Raised floor systems.
  - 4. Underfloor grounding grids (a.k.a. "supplemental bonding grids" or SBGs) for computer or telecommunications rooms.
  - 5. Metallic raceway systems, including metallic cable trays.
  - 6. Communications equipment enclosures (cabinets) or cross-connect frames.
  - 7. Broadband passive devices.
  - 8. Metallic splice cases.
  - 9. Metallic cable screens, armor, or shields.
  - 10. All metal cable conduit.
  - 11. Electrical service panels in entrance facilities, telecommunications, and equipment rooms.
  - 12. Wall and rack mounted grounding busbars.
  - 13. Exposed building steel that is within 6 feet of equipment racking systems.
  - 14. Building steel extending to earth in outside-plant.
  - 15. All related bonding accessories.

#### 1.6 SUBMITTALS

- A. Submit the following:
  - 1. The Contractor shall provide product submittals for all system components as defined in Part 2 of this specification section and all associated project specifications. These components shall include all grounding and bonding products required for a complete grounding and bonding system.
  - 2. Where multiple products are shown on one cut sheet, circle product to be used.



3. Shop drawings showing construction details and locations of components, and description and routing of interconnecting cabling.
  4. Field-testing organization certificates, signed by the Contractor, certifying that the organization performing the tests complies with the requirements specified in Quality Assurance below.
- B. The selected Contractor will allow sufficient time in project scheduling for client and review by the Architect and Technology Consultant.

## 1.7 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings of types and rating required, and ancillary grounding materials, including stranded cable, copper braid and bus, ground rods and plate electrodes, whose products have been in satisfactory use in similar service for not less than 3-years.
- B. Installer: Qualified with at least 3-years of successful installation experience on projects with technology ground work similar to that required for this project.
- C. Listing and labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electric Code, Article 100.
- D. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- E. Field-testing Organization Qualifications: To qualify for acceptance, the independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM699, that it has the experience and capability to satisfactorily conduct the testing indicated.
- F. Component Standard: Components and installation shall comply with NFPA 70, "National Electric Code" (NEC).
- G. UL Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to electrical and electronic grounding.
- H. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical and electronic grounding.

## PART 2 - PRODUCTS

### 2.1 GROUNDING AND BONDING PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. B-Line Systems, Inc.
  2. Burndy Corp.
  3. Crouse-Hinds Co.
  4. Electrical Components Division; Gould Inc.
  5. General Electric Supply Co.
  6. Ideal Industries, Inc.
  7. Panduit.

8. Thomas & Betts Corp.

## 2.2 PRODUCTS

- A. Supply types indicated and of sizes and rating to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

## 2.3 CONDUCTOR MATERIALS

- A. Copper with minimum 98% conductivity.

## 2.4 WIRE AND CABLE CONDUCTORS

- A. Coordinate with Division 26 Sections.
- B. Equipment Grounding Conductor: Green insulated.
- C. Grounding Electrode Conductor: Stranded cable.
- D. Bare Copper Conductors:
  1. Conform to the following:
    - a. Solid Conductors: ASTM B-3.
    - b. Assembly of Stranded Conductors: ASTM B-8.
    - c. Tinned Conductors: ASTM B-33.

## 2.5 MISCELLANEOUS CONDUCTORS

- A. Ground Bus: Bare annealed copper bars of rectangular cross section. All bus bars shall be two-hole lug type.
- B. Bonding Strap Conductor/Connectors: Soft copper, 0.05-inch-thick and 2 inches wide, except as indicated.
- C. Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gauge bare copper wire, 3/4" wide, 9-1/2" long; 48.250cm. Protect braid with copper bolt hole ends with holes sized for 3/8" diameter bolts.

## 2.6 CONNECTOR PRODUCTS

- A. Listed and labeled as grounding connectors for materials used and approved by a nationally recognized testing laboratory.
- B. Pressure Connectors:
- C. High-conductivity-plated units.
  1. All lugs shall be two-hole type.

- D. Bolted Clamps: Heavy-duty units listed for the application.

## 2.7 GROUNDING ELECTRODES

- A. For technology systems, provide a #2 AWG minimum insulated stranded copper conductor from the grounding electrode system to each telecommunication room, terminal cabinet, and central location.
- B. Bonding Plates, Connectors, Terminals, and Clamps: Provide electrical bonding plates, connectors, terminals, lugs, and clamps as recommended by manufacturers for indicated applications.
- C. Connectors, Terminals, and Clamps will be compression type.
- D. Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials and bonding straps, as recommended accessories by manufacturers.

## 2.8 PIPE CLAMPS

- A. Used to ground copper code conductor to water pipe or copper tubing.
- B. Cast from high strength, electrolytic bronze to provide reliable grounding connections.
- C. Plated steel screws provide high strength and inhibit corrosion.
- D. Accommodates a wide range of pipe, tube, rod, and conductor sizes - minimizes inventory.
- E. cULus 467 Listed for grounding and bonding with AWG conductor.
- F. Reference bronze grounding pipe clamps are as follows:
  - 1. Panduit #GPC2-1-Q for pipe range 1/2 – 1" and conductor size range #10 SOL - #2 STR.
  - 2. Panduit #GPC2-2-L for pipe range 1 1/4 – 2 and conductor size range #10 SOL - #2 STR.
  - 3. Panduit #GPC2-4-X for pipe range 2 1/2 – 4 and conductor size range #10 SOL - #2 STR.
  - 4. Panduit #GPC2-6-X for pipe range 4 1/2 – 6 and conductor size range #10 SOL - #2 STR.

## 2.9 COMPRESSION-TYPE ALUMINUM-TO-COPPER REDUCING SPLICE

- A. Dual rated for use with aluminum or copper conductors.
- B. Factory pre-filled with joint compound and sealed with easy pull-out end plug to inhibit corrosion.
- C. Color-coded end plug and Panduit die index numbers marked on barrel for proper crimp die selection.
- D. Tin-plated to inhibit corrosion.
- E. For use up to 35 KV and temperature rated 90°C when crimped with Panduit crimping tools and dies.
- F. Reference compression type aluminum to copper reducing splices are:

1. Panduit #SAR2-4-X for bonding aluminum conductor size #2 AWG to Aluminum or copper conductor size #4 AWG.

## 2.10 COPPER AND ALUMINUM ONE-HOLE GROUNDING LAY-IN LUG FOR BONDING LADDER RACK

- A. Used for quick installation of a continuous grounding conductor.
- B. cULus 467 Listed for grounding and bonding, copper lugs. UL Listed for direct burial in earth or concrete.
- C. cULus Listed for use up to 600 V and temperature rated 90°C.
- D. Reference copper and aluminum one-hole grounding lay-in lug for bonding ladder racks are:
  1. Panduit #LIC4-22-C copper body, 0.22-inch stud hole, conductor size range AWG #14 SOL - #4 STR.
  2. Panduit #LIC4-22TP-C tin plated copper body, 0.22-inch stud hole, conductor size range AWG #14 SOL - #4 STR.
  3. Panduit #LIAC4-22-C tin plated aluminum body, 0.22-inch stud hole, conductor size range AWG #14 SOL - #4 STR.
  4. Panduit #LIAS250-56-Q tin plated aluminum body, 0.33-inch stud hole, conductor size range AWG #6 SOL – 250 KCMil STR.

## 2.11 COMMUNICATIONS GROUNDING RODS

- A. Material: Copper-clad steel.
- B. Size: 3/4-inch by 8 feet long.
- C. Standards: Meet requirements of ANSI®/UL 467-1984, CSA, and ANSI/NEMA GR-1.
- D. Approved manufacturers:
  1. Erico

## 2.12 ELECTROLYTIC GROUND RODS

- A. Where standard ground rods do not have acceptable levels of conductivity (typically greater than 5 ohms resistance) to earth due to local soil conditions, electrolytic systems may be considered.
- B. Such systems shall meet the following:
  1. Be comprised of a hollow Stainless-steel steel or copper tube 10 feet or longer and filled with a mixture of hygroscopic electrolytic salts.
  2. Function as an active grounding system by absorbing moisture out of the air and constantly leaching and electrolytic solution into the surrounding soil to maintain high conductivity.
  3. Rod shall be encased in a conductive, non-corrosive carbon based back fill material.
  4. Provide low resistance to ground.
  5. Provide season to season stability.
  6. Be maintenance-free for 30 years.
  7. Contain no hazardous materials or chemicals.

2.13 TELECOMMUNICATIONS BONDING BACKBONE (TBB) GROUNDING CONDUCTORS

- A. To be bare or insulated copper, of minimum conductor size #6 AWG and sized at 2 KCMil per linear foot up to a maximum size of 750 KCMil.
- B. Where un-insulated, to be identified with green tape at termination location.
- C. Labeled in accordance with recommendations set forth in ANSI/TIA-606-D Administration Standard for Telecommunications Infrastructure.
- D. Approved manufacturers:
  - 1. General Cable
  - 2. Southwire

2.14 TWO-HOLE, LONG-BARREL COPPER COMPRESSION LUGS FOR GROUNDING CONDUCTORS

- A. Meets TIA-607-D requirements for network systems grounding applications.
- B. Tested by Telcordia - meets NEBS Level 3 with AWG conductor.
- C. UL Listed and CSA Certified with AWG conductor for use up to 35 KV\*\* and temperature rated 90°C when crimped with Panduit crimping tools and dies.
- D. Color-coded barrels marked with Panduit die index numbers for proper crimp die selection.
- E. Have long barrel to maximize number of crimps and provides premium wire pull-out strength and electrical performance.
- F. Have "inspection window" over tongue to visually assure full conductor insertion.
- G. Be tin-plated to inhibit corrosion.
- H. Available with NEMA and BICSI hole-sizes and spacing.
- I. Reference two-hole, long-barrel copper compression lugs for grounding conductors are:
  - 1. Panduit #LCC-W series

2.15 CODE/FLEX CONDUCTOR H-TAPS

- A. Used as a splice, or to tap smaller (pigtail) conductors into larger continuous conductors.
- B. Each HTAP terminates a wide range of conductor sizes and combinations of code and flex conductors Class G, H, I and Locomotive to suit a variety of applications.
- C. Slotted design allows quick and easy assembly of conductor to HTAP using three Panduit 94V-0 cable ties.
- D. Tap grooves are separated from one another, allowing them to function independently so HTAP can be used with single or multiple conductors, providing maximum design and installation flexibility.

- E. Color coded and marked with Panduit die index numbers for proper crimp die selection.
- F. UL Listed and CSA Certified, with wide size range of conductor sizes and rated for applications up to 600 V when crimped with Panduit tools and dies.
- G. Tin plated to inhibit corrosion.
- H. Available with an assortment of clear covers with integrated label fields.
- I. Reference parts for HTAPs and clear covers are:
  - 1. Panduit #HTCT series - must be selected according to AWG size of run and tap conductors.
  - 2. Panduit #CLRCVR series clear covers for HTAPs - must be selected according to HTAP being covered.

#### 2.16 CODE CONDUCTOR, THIN WALL, TIN-PLATED C-TAP (SPLICE)

- A. For copper-to-copper splicing or pigtail tap splicing.
- B. Wide wire range-taking capability minimizes inventory requirements.
- C. Color-coded for proper crimp die selection.
- D. Ribbed design provides high strength.
- E. Made from high conductivity wrought copper.
- F. Tin-plated to inhibit corrosion and oxidation.
- G. UL Listed and CSA Certified with AWG conductor to 600 V and temperature rated to 90°C when crimped with Panduit crimping tools and dies.
- H. Reference parts for C-TAPs are:
  - 1. Panduit #CTAPF series - must be selected according to AWG size of conductors being spliced.

#### 2.17 IEEE UNIVERSAL BEAM GROUNDING CLAMP

- A. For bonding structural steel (ex: I-beams) into bonding network.
- B. Universal, fits on a wide range of standard (angled) and wide flange (parallel) structural steel beams.
- C. Provide a mounting pad suitable for a two-hole compression lug.
- D. Installs quickly and easily with standard 1/4" key hex wrench tooling.
- E. UL 467 Listed and CSA 22.2 Certified for grounding and bonding suitable for direct burial in earth or concrete.
- F. Comply with vibration tests per MIL-STD-202G (METHOD 201A).

- G. Reference parts for beam grounding clamps are:
  - 1. Panduit #GUBC500-6 for copper conductor sizes ranging from #6 AWG to 500 KCMil and flange thickness from .25" to .675". Stud size is 1/2" with hole spacing for two-hole lug being 1.75" and thread size from 1/2 to 13.

#### 2.18 SPLIT BOLT FOR BONDING CABLE TRAYS

- A. Made from high strength copper alloy to resist corrosion and provide premium electrical and mechanical performance.
- B. Wire range-taking capability minimizes inventory requirements.
- C. Nut hex provides correct fit with socket, box, or open-end wrenches resulting in proper torquing of electrical connection.
- D. Pressure bar provides secure connection on a full range of conductor combinations used with each connector assuring premium wire pull-out strength.
- E. UL Listed and CSA Certified with AWG conductor for use up to 600 V and temperature rated 90°C.
- F. Available in tin-plated version for bonding to galvanized wire baskets and Flex Tray.
- G. Reference parts are:
  - 1. Panduit #SBC3-C split lug for #8 AWG to #4 AWG code conductors.
  - 2. Panduit #SBCT3-C split lug for #8 AWG to #4 AWG code conductors - tinned for use with galvanized basket tray delivery systems.

#### 2.19 AUXILIARY CABLE BRACKETS (CONDUCTOR PATHWAY)

- A. Used for mounting telecommunications bonding conductors outside of cable tray.
- B. Maintain minimum 2" separation between bonding conductors and all other types of cabling per TIA-607-D.
- C. Bonds ladder rack, wire basket sections together without drilling holes or applying other split-bolt clamps.
- D. Supports grounding conductors in the telecommunications room, allows separation of grounding conductors from other cables.
- E. Holds up to four conductors in sizes up to 750 KCMil.
- F. Bonds to all 1" and 2" ladder rack rails.
- G. Paint piercing teeth provide electrical continuity between cable pathway sections while minimizing debris.
- H. Front and back mounting screw options allow easy installation and visual inspection.
- I. Can be mounted above or below the cable pathway system for flexibility.

- J. Meet requirements TIA-607-D.
- K. Have available bonding jumper kits to bond sections of basket tray or ladder rack.
- L. Reference parts are:
  - 1. Panduit #GACB-2 auxiliary cable bracket; 1.63" (41.4mm) width, 3.95" (100.3mm) height, 5.22" (132.6mm) depth; provided with one mounting screw.
  - 2. Panduit #GACBJ612U auxiliary cable bracket jumper for bonding pathway sections; #6 AWG (16mm<sup>2</sup>); 12.0" (305mm) length; factory terminated on both ends with straight, two-hole, long barrel compression lugs; provided with .16 oz. (5cc) of antioxidant and four mounting screws.

## 2.20 WALL-MOUNT BUSBARS (TGB AND TMGB AND LABELING)

- A. Meet BICSI and TIA-607-D requirements for network systems grounding applications.
- B. Employ BICSI hole spacing to fit LCC-W series 2-hole lugs.
- C. Be made of high conductivity copper and tin-plated to inhibit corrosion.
- D. Come pre-assembled with brackets and insulators attached for quick installation.
- E. Use Panduit component labels, sold separately, to identify busbars to meet TIA-606-D.
- F. Reference part is:
  - 1. Erico EGBA14218EE 1/4x2x18" grounding busbar (TGB) with 15 mounting position with 7/16" stud hole with 3/4" and 1" hole spacing.

## 2.21 VERTICAL GROUNDING STRIP BUSBARS FOR NEW INSTALL RACKS AND CABINETS

- A. Provides clean bond to any rack mounted equipment regardless of whether or not equipment has an integrated grounding terminal.
- B. Bonds up to 45 RU per rack.
- C. Comes in EIA/ECA Universal mounting hole pattern.
- D. Complies with US and International grounding requirements.
- E. Comes in threaded rail and cage nut versions.
- F. Reference parts are:
  - 1. Panduit #RGS134-1Y grounding strip for use with threaded rails; 78.65" (2m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
  - 2. Panduit #RGS134B-1 grounding strip for use with cage nut rails; 78.70" (2m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three cage nut bonding studs, eight #12-24 bonding nuts and three strip clips.



3. Panduit #RGS13442-1 grounding strip for use with threaded rails; 73.70" (1.9m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
4. Panduit #RGS13448-1 grounding strip for use with threaded rails; 83.90" (2.1m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
5. Panduit #RGS13451-1 grounding strip for use with threaded rails; 89.15" (2.3m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
6. Panduit #RGS13452-1 grounding strip for use with threaded rails; 90.90" (2.3m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
7. Panduit #RGS134B42-1 grounding strip for use with cage nut rails; 73.40" (1.9m) length; .67" (17mm) width; .03" (.76mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three cage nut bonding studs, eight #12-24 bonding nuts and three strip clips.
8. Panduit #RGS134B48-1 grounding strip for use with cage nut rails; 83.90" (2.1m) length; .67" (17mm) width; .03" (.76mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker, three cage nut bonding studs, eight #12-24 bonding nuts and three strip clips.

## 2.22 RETROFIT CABINET AND RACK GROUNDING KITS FOR REMEDIATION OF UN-GROUNDED LEGACY RACKS AND CABINETS:

- A. Provide a dedicated ground system to maintain system performance and protect network equipment when equipment is already installed.
- B. Hardware that incorporates paint piercing serrations to create a bond point between the cabinet rail, grounding busbar and lug.
- C. Hardware installable without removal of existing installed equipment.
- D. Cabinet kits optimized for installation on 19" cabinets that meet EIA/ECA-310, with functioning equipment are already mounted.
- E. A complete system of integrated and matched components
- F. Engineered to comply with US and International grounding requirements.
- G. Rack kits optimized for installation on 19" racks that meet EIA/ECA-310, with functioning equipment, and are deployed in the field.
- H. Incorporates thread-forming screws to eliminate the need to manually remove paint from the rack.
- I. Reference parts are:
  1. Panduit #CGR630U retrofit grounding kit for installation on ungrounded existing cabinets with threaded #12-24 or M6 rail fasteners and rail depth up to 30" (.75m); includes one RGRB19U grounding busbar kit and one CGJ630U front to back rail jumper kit.
  2. Panduit #CGR630UB retrofit grounding kit for installation on ungrounded existing cabinets with cage nut rail fasteners and rail depth up to 30" (.75m); includes one RGRB19U grounding busbar kit and one CGJ630UB front to back rail jumper kit.

3. Panduit #RGRKCBNJY rack grounding kit to ground an existing rack with equipment already mounted; includes one RGRB19U busbar, one HTCT250-2-1 HTAP, and one RGREJ696Y grounding jumper.

## 2.23 RACK BONDING CONDUCTOR KITS (RBC)

- A. Bonds the rack or cabinet to the telecommunications grounding busbar (TGB or TMGB).
- B. Jumper kits available with both ends factory terminated to provide a bolt-on solution.
- C. Jumper kits available with one end factory terminated to attach to the rack or cabinet; free end accommodates unique length requirements.
- D. Engineered to comply with US and international grounding requirements.
- E. Reference parts are:
  1. Panduit #GJ672UH terminated on both ends for smaller telecommunications rooms where racks have individual connections directly to the TMB. One 72" length #6 AWG green wire with yellow horizontal stripe. Jumper is pre-terminated on one end with LCC6-14JAWH-L and the other end with LCC6-14JAW-L. Comes in lengths 72", 96", 120", 144", 168", 192", 216", 240", 264", and 288". For other lengths substitute "72" in part number with desired length.
  2. Panduit #GJS6120U terminated on one end for larger telecommunications rooms where racks are individually bonded to underfloor or overhead bonding backbone with an HTAP connection. One 120" length #6 AWG green wire with yellow horizontal stripe. Jumper is pre-terminated on one end with LCC6-14JAW-L. For 180" length substitute "120" in part number with "180"
  3. Panduit # HDW1/4-A-KT Stainless-steel steel mounting hardware for busbar; two 1/4-20 hex bolts, two 1/4-20 hex nuts, four 1/4 flat washers and two 1/4 Belleville compression washers. Mounting hardware for rack or cabinet; two #10-32 thread-forming screws and two M5 thread-forming screws.
  4. Panduit #HDW3/8-A-KT Stainless-steel steel mounting hardware for busbar; two 3/8-16 hex bolts, two 3/8-16 hex nuts, four 3/8 flat washers and two 3/8 Belleville compression washers. Mounting hardware for rack or cabinet; two #10-32 thread-forming screws and two M5 thread-forming screws.

## 2.24 ELECTROSTATIC DISCHARGE (ESD) PORT KITS AND WRIST STRAP

- A. For dissipating electro-static buildup prior to maintenance work on network equipment.
- B. Accommodate standard ESD wrist strap 4mm plug.
- C. Wrist strap provides rapid and continuous drain of electrostatic charge between a person and the surface to which the wrist strap is bonded, thus preventing damaging static discharge into equipment.
- D. Can be mounted to front or back of rack or cabinet for convenient access.
- E. Bent 45° to act as a hook to hold wrist strap when not in use.
- F. Two-hole configuration provides anti-rotation and prevents loss of bond.

- G. Barrel permanently marked with the protective earth (ground) symbol.
- H. Engineered to comply with US and International grounding requirements.
- I. Versions for threaded racks rails or cabinet cage nuts.
- J. Reference parts are:
  - 1. Panduit #RGESD2-1 for #12-24 or M6 rail fasteners: Two-hole ESD port with 5/8" hole spacing; provided with an ESD protection sticker, .16 oz. (5cc) of antioxidant, and two each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
  - 2. Panduit #RGESD2B-1 for cage nut rail fasteners: Two-hole ESD port with 5/8" hole spacing; provided with an ESD protection sticker, .16 oz. (5cc) of antioxidant, two cage nut bonding studs and two #12-24 bonding nuts.
  - 3. Panduit #RGESDWS adjustable fabric ESD wrist strap with 6' coil cord, banana plug, 1 megaohm resistor and 4mm snap.

#### 2.25 EQUIPMENT JUMPER KITS (UNIT BONDING CONDUCTOR OR "UBC")

- A. Used to ground large, chassis-style rack mounted equipment that have built-in grounding pads or terminals.
- B. Bond network equipment to grounding strip or grounding busbar.
- C. Jumper kit available with both ends factory terminated to provide a bolt-on solution.
- D. Jumper kit available with one end factory terminated to attach to the grounding strip or grounding busbar; free end accommodates unique equipment terminations.
- E. Use jumpers with 90° bent lug, on grounding strip side, for high density grounding requirements up to one ground point per RU.
- F. Use jumpers with 45° bent lugs on grounding strip side, for improved cable management.
- G. Engineered to comply with US and International grounding requirements.
- H. Reference parts are:
  - 1. Panduit #GJS6 series #6 equipment jumper factory terminated on one end for switches, cabinets and 4 post racks. Exact part number depends on length.
  - 2. Panduit #RGE series factory terminated jumpers that are terminated on both ends. Exact part number depends on AWG size, length, and angle of two-hole lugs.

#### 2.26 SURGE SUPPRESSOR JUMPER KIT

- A. Bonds power or data line surge suppressor to grounding strip or grounding busbar.
- B. Both ends factory terminated to provide a bolt-on solution.
- C. Engineered to comply with US and International grounding requirements.
- D. Reference parts are:

1. Panduit #SSGK-1 #10 AWG (6mm<sup>2</sup>) jumper; 24" (.61m) length; factory terminated on both ends; one-hole lug on surge suppressor to two-hole lug on grounding strip/busbar side; provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread-forming screws.

## 2.27 ARMORED CABLE GROUNDING KIT

- A. Provides a secure bond to the armor sheath on indoor and indoor/outdoor fiber optic cables at both cassette and enclosure ends.
- B. Worm-gear design evenly distributes forces across the armor.
- C. Made from steel and aluminum material is compatible with common armor for long term reliability.
- D. Black insulating cover protects and hides the connection for an aesthetically pleasing work area.
- E. Complies with industry requirements ensuring a high level of reliability and safety.
- F. Reference parts are:
  1. Panduit #ACG24K #6 AWG (16mm<sup>2</sup>) jumper for armored cable diameter up to 0.84" (21.3mm); 24" (609.6mm) length; factory terminated on one end with LCC6 two-hole copper compression lug and the other end with grounding terminal; provided with two each #12-24 and M6 thread-forming screws and a black polypropylene terminal cover.
  2. Panduit #ACG24K-500 #6 AWG (16mm<sup>2</sup>) jumper for armored cable diameter 0.85" (21.3mm) to 1.03" (26.2mm); 24" (609.6mm) length; factory terminated on one end with LCC6 two-hole copper compression lug and the other end with grounding terminal; provided with two each #12-24 and M6 thread-forming screws and a black polypropylene terminal cover.
  3. Panduit #ACGK armored cable grounding kit. Contains one grounding terminal for #6 AWG grounding conductor, and one #10 mechanical clamp for cable diameters in 9/16" – 1 1/16" diameter range.

## 2.28 MISCELLANEOUS BONDING ACCESSORIES:

- A. Anti-oxidation Paste (contact aid) For Copper to Copper and Copper to Steel Connections.
- B. Anti-oxidation Paste (contact aid) For Aluminum Pad-to-Pad or Thread-to-Thread Aluminum Connections.
- C. Green thread-forming bonding screws for bonding smaller equipment on threaded rack rails through the equipment mounting flange.
- D. Green bonding cage nuts from bonding smaller equipment on cage nut rails through the equipment mounting flange.
- E. Thread forming screws for bonding two-hole lugs to Rack Bonding Busbar (RBB) on threaded rack rails.
- F. Green paint piercing grounding washers for assuring electrical continuity between painted parts of equipment racks as described in TIA-607-D Standard.

- G. Bonding hardware kits (studs) for forming low-resistance bond between the rack or cabinet and painted rack mounted appliances and equipment.
- H. Reference parts are:
1. Panduit #CMP-300-1 contact aid (antioxidant paste) for copper-to-copper and copper-to-steel connections in 8 oz container. Operating temperature range -40°F (-40°C) to 350°F (177°C). Good for all voltages and suitable for grounding. Also, may be used for anti-seizing thread lubricant.
  2. Panduit #CMP-100-1 contact aid (antioxidant paste) for pad-to-pad or thread-to-thread aluminum connections made on aluminum conductor in 8 oz container. Operating temperature range -40°F (-40°C) to 400°F (204°C).
  3. Panduit #RGTBSG-C green thread-forming bonding screw, #12-24 x 1/2" for mounting smaller equipment and bonding to rack/cabinet racks through equipment mounting flange.
  4. Panduit #RGTBS1032G-C green thread-forming bonding screw, #10-32 x 1/2" for mounting smaller equipment and bonding to rack/cabinet racks through equipment mounting flange.
  5. Panduit #CNB4K green bonding cage nut, includes 4 #12-24 bonding cage nuts (.06 – .11 thick panel) and 4 #12-24 x 1/2" bonding screws with #2 Phillips/slotted combo hex head (use 5/16" or 8mm socket). Ideal for patch panel applications.
  6. Panduit #CNBK green bonding cage nut, includes 50 #12-24 bonding cage nuts (.06 – .11 thick panel) and 50 #12-24 x 1/2" bonding screws with #2 Phillips/slotted combo hex head (use 5/16" or 8mm socket).
  7. Panduit #RGW-100-1Y 100 paint piercing bonding washers for 3/8" (M8) stud size; .875" (22.2mm) O.D.; provided with .16 oz. (5cc) of antioxidant.
  8. Panduit #TRBSK bonding stud kit for threaded #12-24 rail fasteners; includes 25 bonding studs and 50 bonding nuts for bonding painted equipment and appliances to rack/cabinet rails and vertical busbars.
  9. Panduit #CGNBSK bonding stud kit for cage nut rail fasteners; includes 25 bonding studs and 50 bonding nuts for bonding painted equipment and appliances to rack/cabinet rails and vertical busbars.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General:
1. This Specification document describes a generic enterprise communications bonding and grounding system for the construction of a complete and functioning grounding system. It is the responsibility of the installing Contractor to adapt these general guidelines and principles to the requirements of the actual environments where the systems are to be implemented.
  2. System shall provide equipment ground connections (bonds) from the premises entrance facility and outside-plant earthing system to each telecommunication room telecommunication ground busbar, through the racking systems to bond the network equipment.
  3. Entire grounding link from equipment to earth should be visually verifiable except where hidden by walls, conduit, or pathways.
  4. Installing Contractor shall label all elements of the communications bonding network according to guidelines defined in TIA-607-D and ANSI/TIA-606-D.
  5. It is the responsibility of the installer to be knowledgeable of all previously cited Standards and Codes and to bring to the attention of Architect and Technology Consultant any

conflicts or discrepancies to achieve a fully functioning, standards-compliant earthing system.

6. Contractors working around or adding to existing legacy systems shall bring to the attention of Architect and Technology Consultant previously installed network elements that may not comply with modern grounding requirements for possible remediation.

B. Telecommunications Bonding Backbone (TBB):

1. Bonding and grounding conductors may be insulated or un-insulated and shall not decrease in size as the grounding path moves closer to earth.
2. Connections (bonds) between the telecommunications grounding network and associated electrical panels shall be done by a qualified electrician in accordance with guidelines in TIA-607-D and applicable electrical codes.
3. Bonding Conductors should be continuous and routed in the shortest possible straight-line path, avoiding changes in elevation and sharp bends.
4. TBB conductors shall be protected from mechanical damage and built so as to minimize splicing. Where splicing is unavoidable, they shall be done using irreversible compression splices (C-TAPS) built to that purpose. See the "Materials" section of this document for appropriate compression splices.
5. TBB in multi-story buildings with multiple risers (multiple TBBs) shall employ a Backbone Bonding Conductor (BBC) or grounding equalizer (GE) between vertical grounding backbones at the top floor of the building and minimally at every third floor in between to the lowest floor level. The BBC shall be no smaller than the largest sized TBB.
6. Routing grounding conductors through ferrous metal conduit should be avoided, but if it is necessary due to building constraints, any grounding conductor running through ferrous conduit longer than 3 feet shall be bonded at the end using appropriately sized HTAP and Conduit grounding clamps as described TIA-607-D using appliances described for that purpose in the "Materials" section of this document.
7. Conductors used to bond TBB to conduit ends shall be of #6 AWG size or larger.
8. Conductor sizing shall be based upon project specification (drawings and notes) for that installation. These sizes are based on TBB length per TIA-607-D recommendations. Contractor shall bring to the attention of Architect and Technology Consultant anywhere TBB project specified sizing appears insufficient per the Table below:

Sizing of the TBB	
TBB Length in Linear meters (feet)	TBB Size (AWG)
Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1
13-16 (42-52)	1/0
16-20 (53-66)	2/0
20-26 (67-84)	3/0
26-32 (85-105)	4/0
32-38 (106-125)	250 KCMil
38-46 (126-150)	300 KCMil
46-53 (151-175)	350 KCMil
53-76 (176-250)	500 KCMil
76-91 (251-300)	600 KCMil
Greater than 91 (301)	750 KCMil

C. Entrance Facilities and Telecommunications Main Grounding Busbar (TMGB):

1. TMGB shall be located in the entrance facility, near the electrical panel to which it will be bonded but installed to maintain clearances required by applicable electrical codes.

2. TMGB shall be sized according to the anticipated number of bonded connections needed.
3. TMGB shall have tinned surface to restrain oxidation and be cleaned and antioxidant paste applied prior to fastening conductors.
4. Connectors on TBB which attach to TMGB shall be of two-hole, long-barrel compression lugs of the LCC series as specified in the "Materials" section of this document.
5. Building steel within six feet of the communications grounding system should be bonded into the system with appropriate hardware listed in "Materials" section of this document.
6. All cables containing a metallic shield or armor shall have that shield properly bonded into the communications grounding system using the appropriately sized Armored Cable Grounding Kit listed in the "Materials" section of this document.

D. Telecommunications Rooms and Telecommunications Grounding Busbar (TGB):

1. Each telecommunications room shall have its own TGB to which equipment and dead steel (building steel and support structures) in that room are bonded.
2. The TGBs shall have a tinned surface to inhibit oxidation and be sized according to the anticipated number of bonded connections that will be needed.
3. TGBs shall be sized according to the anticipated number of bonded connections needed.
4. TMGs shall have tinned surfaces to restrain oxidation and shall be cleaned and have an antioxidant paste applied to both bonding surfaces prior to fastening conductors.
5. Connectors on backbone and rack/cabinet bonding conductors which attach to TGB shall be of two-hole, long-barrel compression lugs of the LCC series as specified in the "Materials" section of this document.
6. Building steel within six feet of the communications grounding system should be bonded into the system with beam clamps and other hardware appropriate to that purpose listed in "Materials" section of this document.
7. Racks and cabinets shall have individual Rack Bonding Conductors (RBC) bonding to the Telecommunications Equipment Bonding Conductor (TEBC) or underfloor "Supplemental Bonding Grid - DAISY CHAINING OR SERIAL CONNECTIONS OF ONE RACK OR CABINET TO ANOTHER WILL NOT BE ACCEPTED.
8. Rack Bonding Conductors (RBC) or above rack row grounds (TEBC) shall be installed to maintain a minimum of 2" separation from all other types of cable - power or communications.
9. To maintain this segregation of cables some telecommunications rooms may lend themselves to the installation of Auxiliary Conductor Brackets for routing bonding conductors outside of, yet parallel to ladder rack or basket tray. See "Auxiliary Brackets" in "Materials" section of this document.
10. Bonding conductor support systems like auxiliary brackets shall be spaced no further apart than three-foot intervals.
11. All cables containing metallic shielding or armor shall be properly bonded into the communications grounding system using the appropriately sized Armored Cable Grounding Kit listed in the "Materials" section of this document.

E. Bonding within Racks and Cabinets:

1. Racks and Cabinets shall be bonded into the communications bonding network with conductors of #6 AWG or larger.
2. Racks, cabinets, and similar enclosures shall not be attached serially (daisy-chained) but must have individual RBC into the grounding system.
3. Newly installed racks and cabinets shall have vertical grounding busbars installed along one rail to provide clean bonding landing point for all rack mount equipment. For part numbers of vertical busbars see "Materials" section of this document. Grounding busbars shall not be isolated from the rack or cabinet.
4. All painted components of racks/cabinets shall be assembled using serrated grounding washers and thread-forming screws to ensure electrical continuity between the different structural components of the rack/cabinet.

5. Larger equipment (chassis switches) with integral grounding terminals or pads shall be bonded to the vertical busbar with equipment grounding kits attached to those terminals and bonding them to the rack-mounted busbars. For kit part numbers see the "Materials" section of this document.
6. Anywhere two metallic surfaces are to be bonded, Contractor shall clean the contact areas of paint or oxidation using abrasive pads and apply film of anti-oxidation compound between surfaces prior to bonding.
7. All cable fittings shall be of two-hole (LCC series) compression-type. Mechanical screw-lugs on racking systems will not be accepted and must be removed and replaced at Contractor's expense.
8. All screws used to affix compression lugs to rack-mounted vertical busbars shall be of the thread forming type made specifically for electrical bonding.
9. Smaller equipment (servers, TOR switches) not having integral grounding pads must be bonded to the rack through the equipment mounting flanges using green thread-forming grounding screws with serrations under the head to cut through paint, coatings and oxidation that may be present on the equipment flange. Such equipment shall have minimally one grounding screw per piece of equipment.
10. Existing (installed) racking systems containing live active equipment may be retrofitted for Standards-compliant bonding using rack retrofitting kits listed in the "Materials" section of this document.
11. ESD (electro-static discharge) ports and wrist straps shall be provided minimally every other rack or bay to be within reach of any active equipment. On larger 4-post racks or cabinets - ESD ports and wrist straps shall be installed on the front and back to be accessible when servicing any active equipment.
12. As a condition of employment, any internal or contracting technicians servicing active equipment must be wearing a properly grounded wrist strap to dissipate ESD charges prior to touching any active equipment.

F. Field Quality Control

1. Contractor shall verify the use of all appropriate bonding accessories in the racking systems such as grounding washers, thread-forming grounding screws and the presence of electro-static discharge ports and wrist straps within reach of all equipment to be maintained.
2. Contractor is responsible for visually verifying sizing and sound installation of the telecommunications bonding backbone including presence of properly sized and installed grounding equalizer conductors between backbones contained in separate risers.
3. Inspecting Contractor shall verify that any conduit longer than 3 feet through which a grounding conductor passes is properly bonded to the grounding conductor as described in this document.
4. During inspections Contractor shall verify compliance with all stipulations specified in this document and compliance with all regulatory references (Standards and Codes) cited.
5. All opens or gaps in the bonding system during final inspections will be recorded in the inspection report and remedied.
6. During inspections, Contractor shall check all grounding and bonding system conductors and connections for tightness and proper installation, including checking proper dies were used on compression taps and fittings by checking embossed die numbers on those connections.
7. Architect and Technology Consultant may request a test of 10% of bonded connections within the grounding system with a volt-ohm meter. Resistance tests taken on either side of a compression or exothermic bond shall be less than .2 (2/10) of one ohm in resistance.
8. Bonded joints to be tested may be random or individually tagged by a representative of Architect or Technology Consultant.
9. Contractor shall Test system at bonded points indicated and provide results in report form.



10. Based upon test results, Architect and Technology Consultant reserves the right to request testing on 100% of exothermic and compression bonds within the installed grounding system.
11. All bonded connections failing the test described above shall be remedied and retested by the installation Contractor at Contractor's expense.

END OF SECTION

## **SECTION 27 05 28 – LOW VOLTAGE CONDUIT SYSTEM**

### **PART 1 - GENERAL**

#### 1.01 REFERENCE

- A. Refer to Section 26 00 00 for requirements which are applicable to this section.

#### 1.02 WORK INCLUDED

- A. Provide labor, material, and supervision necessary to install all service and distribution as outlined in this section.

### **PART 2 - PRODUCTS**

#### 2.01 WALL BOXES - TELEPHONE

- A. Single gang galvanized steel with single gang device ring and wall plates.
- B. Modular jack to accept phone system wiring with two RJ-11 connectors.

#### 2.02 WALL BOXES - DATA

- A. Single gang galvanized steel with single gang device ring and wall plates.
- B. Face plate to accommodate data system wiring.

#### 2.03 WALL BOXES - TELEPHONE AND DATA

- A. Double gang galvanized steel with steel divided raceway.
- B. Double face plate with modular RJ-11 jacks for telephone and 2 data outlet grommets.
- C. Two raceways to accessible ceiling space.

#### 2.04 WALL BOXES – CATV

- A. Single gang galvanized steel with single gang device ring and wall plate.
- B. Face plate to accommodate “F” type connectors.

#### 2.05 CONDUIT

- A. 3/4" EMT from boxes to accessible ceiling space.
- B. Two 4" conduits from backboard through building foundation to exterior of the building, with pull wires.
- C. Provide 4" conduit raceway from Demarcation Room to Auxiliary Rooms on each floor.

## 2.06 PLYWOOD BACKBOARDS

- A. Furnish and install 3/4" thick marine grade plywood backpanels of the size and location where indicated.
- B. Install as a minimum a standard quad outlet and an isolated ground outlet at each location.
- C. Install a ground bar and insulated ground cable back to the building electrical service entrance ground.

## **PART 3 - EXECUTION**

### 3.01 CONDUIT SYSTEM

- A. Provide and install where indicated for the device being installed.
- B. Provide pull wire in empty conduit.
- C. Provide ground for system.
- D. Provide 120-volt quad receptacle at telephone backboard.
- E. Provide a 3/4 " thick marine plywood telephone backboard where indicated for use by the Telephone Company for the mounting of equipment.

END OF SECTION

## SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Provisions and Supplementary Conditions, Specification Sections, apply to this and the other sections of Division 27.
- B. This section is a Division 27 BASIC section and is a part of each Division 27 section.

#### 1.2 SUMMARY

- A. This Section includes secure support from the building structure for technology items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.
- B. All support shall utilize threaded fasteners for all technology/attachments.
  - 1. Exception:
    - a. Spring steel fasteners may be used in lieu of threaded fasteners only for  $\frac{3}{4}$ " raceways above suspended ceilings.
- C. Types of supports, anchors, sleeves, and seals specified in this section include the following:
  - 1. C-clamps
  - 2. Clevis hangers
  - 3. Conduit straps
  - 4. I-beam clamps
  - 5. Lead expansion anchors
  - 6. Riser clamps
  - 7. Round steel rods
  - 8. Toggle bolts
  - 9. Wall and floor seals
- D. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment, are specified as part of that equipment assembly, or as specified in Division 26.

#### 1.3 SUBMITTALS

- A. Submit the following in accordance with Conditions of Contract and Supplementary Conditions Specifications Sections.
  - 1. Product Data: Submit manufacturer's data on supporting devices including catalog cuts, specifications, and installation instructions, for each type of support, anchor, sleeve, and seal.
  - 2. Where multiple products are shown on one cut sheet, circle product to be used.
  - 3. Shop Drawings: Submit dimensioned drawings of fabricated products, indicating details of fabrication and materials.

#### 1.4 QUALITY ASSURANCE

- A. **Manufacturers:** Firms regularly engaged in manufacturing of supporting devices, of types, sizes, and ratings requires, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. **Contractor Qualifications:** Firm shall have at least 3 years of successful installation experience with projects utilizing electronic/electrical supporting device work similar to that required for this project.
- C. **NEC Compliance:** Comply with NEC requirements as applicable to construction and installation of supporting devices.
- D. **MSS Compliance:** Comply with applicable MSS standard requirements pertaining to fabrication and installation practices for pipe hangers and supports.
- E. **UL Compliance:** Provide components that are UL listed and labeled.
- F. **FS Compliance:** Comply with Federal Specification FF-S-760 pertaining to retaining straps for conduit, pipe, and cable.
- G. Components shall be listed and labeled by ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Major items of equipment shall have manufacturer's name, address and catalog number on a plate securely attached. All equipment or apparatus of any one system must be the product of one manufacturer or approved equivalent products of a number of manufacturer's that are suitable for use in a unified system.
- B. All materials and equipment for which Underwriter's Laboratories have established standards shall bear a UL label of approval.
- C. Where proprietary names are used, whether or not followed by the words "or as approved," they shall be subject to substitution only as approved by the Architect, Technology Consultant, and Owner.
- D. Where the Contractor proposes substitute equipment, Contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size, and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

## PART 3 - EXECUTION

### 3.1 DELIVERY, STORAGE, AND HANDLING

- A. Provide supporting devices that comply with manufacturer's standard materials. Install in accordance with published product information, and as required for a complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Contractor's option.
- B. Install hangers, anchors, sleeves, and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NEC for installations of supporting devices.
  - 1. Support all technology cables a minimum of every 5ft. with J-hooks unless other supports are available.
  - 2. Cables shall be bundled in groups of 24 cables maximum.
  - 3. Regardless of the size of the J-hooks, no more than (1) bundle of 24-cables may be placed within a single J-hook.
- C. Coordinate with the building structural system and electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- D. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- E. Obtain approval from the Architect before drilling or cutting structural members.
- F. Install surface-mounted cabinets and panels with minimum of four anchors.

### 3.2 MISCELLANEOUS SUPPORTS

- A. Support miscellaneous technology components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panels, control enclosures, pull boxes, junction boxes and other devices.

### 3.3 FASTENING

- A. Unless otherwise indicated, fasten technology items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, cabinets, panels, boxes, and control components in accordance with the following:
- B. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts, or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
- C. Holes cut into reinforced concrete beams or in concrete shall not cut reinforcing bars. If the Contractor cuts into any reinforcing bars, stop work and notify the Technology Consultant immediately. Fill all holes that are not used.

- D. Ensure that the load applied to any fastener does not exceed 25% of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.

### 3.4 TESTS

- A. Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:
  - B. Expansion anchors.
    - 1. Toggle bolts.
    - 2. Powder-driven threaded studs.
  - C. Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain and submit the Structural Engineer's signed approval before transmitting loads to the structure. Test to 90% of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

END OF SECTION

## SECTION 270536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Continuous, rigid, welded steel or Stainless-steel-steel wire mesh cable management system.
- B. Cable tray systems are defined to include, but are not limited to, straight sections, supports and accessories.

#### 1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.3 SUMMARY

- A. Related Sections include the following:

1. Section 270100 - Operations and Maintenance of Structured Cabling Enclosures
2. Section 270526 – Grounding and Bonding for Communications Systems
3. Section 270529 - Hangers and Supports for Communications Systems
4. Section 270553 – Identifications for Communications Systems
5. Section 270800 – Commissioning Communications Systems
6. Section 271100 – Communications Room Equipment Fittings
7. Section 271300 – Communications Backbone Cabling
8. Section 271500 – Communications Horizontal Cabling
9. Section 271600 – Communications Connecting Cords, Devices and Adapters

- B. References:

1. IEC 61537 (2001) – Cable Tray Systems and Cable Ladder Systems for Cable Management
2. NEMA VE 1-2002/CSA C22.2 No. 126.1-02 – Metal Cable Tray Systems
3. ANSI/NFPA 70 (2005) – National Electrical Code (NEC)
4. TIA 569-E (2019) – Commercial Building Standard for Telecommunications Pathways & Spaces
5. ASTM A 510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
6. ASTM A 380 – Specification for Standard Practice for Cleaning, Descaling, and Passivation of Stainless-steel Steel Parts, Equipment, and Systems
7. ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
8. ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
9. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality



#### 1.4 SUBMITTALS

- A. Comply with requirements of Section 013300 – Submittal Procedures.
- B. Product Data: Submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including UL Classification and NEMA/CSA Certification.
  - 1. Where multiple products are shown on one cut sheet, circle product to be used.
- C. Shop Drawings: Submit shop drawings indicating materials, finish, dimensions, accessories, layout, supports, splices, and installation details.
- D. Design Calculations: Verify loading capacities for supports.
- E. Coordination Drawings: Include floor plans and sections drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural and mechanical elements. Data presented on these drawings are as accurate as preliminary surveys and planning can determine. Field verification of all dimensions, routing, etc., is directed.
- F. Factory-certified test reports of specified products, complying with IEC 61537, NEC, and NEMA VE 1/CSA C22.2 No. 126.1.
- G. Submit manufacturer's certification indicating ISO 9001 quality certified.
- H. Submit training procedure for certifying cable tray installers.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.
- B. Approval and Labeling: Provide cable trays and accessories specified in this Section that are approved and labeled.
  - 1. The Terms "Classified" pertaining to cable trays (rather than "Listed") and "Labeled": As defined in NFPA 70, Article 100, including painted trays.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- C. Comply with NFPA 70, National Electrical Code, Article 392: Cable Trays; provide UL Classification and labels.
- D. Comply with IEC 61537, Cable Tray Systems and Cable Ladder Systems for Cable Management.
- E. Comply with NEMA VE 1/CSA C22.2 No. 126.1, Metal Cable Tray Systems, for materials, sizes, and configurations; provide CSA/US Certificate and labels.
- F. Provide documentation of the following certifications:
  - 1. ISO 9001 quality certification.
  - 2. American Bureau of Shipping (ABS) Product Design Assessment certification.
  - 3. E 90 Fire Testing certification.
  - 4. VDE certification.

## 1.6 COORDINATION

- A. Coordinate layout and installation of cable tray with other installations.
  - 1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.
  - 2. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. Subject to compliance with requirements, provide products by the following:
  - 1. Cablofil, Inc., 8319 State Route 4, Mascoutah, IL, 62258. Phone: (618) 566-3230. Toll-Free: (800) 658-4641. Fax: (618) 566-3250. Website: [www.cablofil.com](http://www.cablofil.com). Email: [Info@cablofil.com](mailto:Info@cablofil.com).

### 2.2 MATERIALS AND FINISHES:

- A. Cable Tray Materials: select one of the following:
  - 1. Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.
- B. Cable Tray Finishes:
  - 1. Finish for Carbon Steel Wire after welding and bending of mesh; select one of the following:
    - a. Electrodeposited Zinc Plating: ASTM B 633, Type III, SC-1.
  - 2. Finish for Stainless-steel Steel Wire: According to ASTM B 380.
- C. Cable tray will consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray (including UL Classified painted tray) acts as Equipment Grounding Conductor (EGC). Wire mesh cable tray will have continuous Safe-T-Edge T-welded top side wire to protect cable insulation and installers.
- D. Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.
  - 1. Straight Section Lengths: 120 inches (3,000 mm).
  - 2. Wire Diameter: Patented design includes varying wire sizes to meet application load requirements; to optimize tray strength; and to allow tray to remain lightweight.
  - 3. Safe-T-Edge: Patented Safe-T-Edge technology on side wire to protect cable insulation and installers' hands.
  - 4. Fittings: Wire mesh cable tray fittings are field fabricated from straight tray sections, in accordance with manufacturer's instructions and Item 2.3.
  - 5. FlexTray Cable Tray Size:
    - a. Depth: Cable tray depth will be 4 inches:

- b. Width: Cable tray width will be 6, 8, 12, 16, 18, 20 & 24 inches (unless otherwise shown on drawings):
  - c. Length: Cable tray section length will be 120 inches (3000mm) unless otherwise shown on drawings.
  - d. Fill Ratio: Cable tray may be filled to total fill capacity per NEC. Minimum 40% spare capacity recommended accommodates future cabling changes or additions.
  - e. Load Span Criteria:
  - f. Cable tray will be capable of carrying a uniformly distributed load of 50 pounds per foot on an 8 ft support span, according to load tests of standard shown in Item A above.
6. Cablofil cable basket/tray part numbers:
- a. CF 105/150: 4 inches height x 6 inches width x 120 inches length
  - b. CF 105/200: 4 inches height x 8 inches width x 120 inches length
  - c. CF 105/300: 4 inches height x 12 inches width x 120 inches length
  - d. CF 105/450: 4 inches height x 18 inches width x 120 inches length
  - e. CF 105//500: 4 inches height x 20 inches width x 120 inches length
  - f. CF 105/600: 4 inches height x 24 inches width x 120 inches length
  - g. Or Approved Equals

## 2.3 CABLE TRAY SUPPORTS AND ACCESSORIES

- A. Fittings/Supports: Wire mesh cable tray fittings are field fabricated from straight tray sections, in accordance with manufacturer's instructions. Supports will include the FAS (Fast Assembly System) where possible so that screws, bolts, and additional tools are not required for cable tray mounting; installation time is reduced; and tray path can adapt to installation obstacles without the need for additional parts. Place supports so that support span does not exceed that shown on the drawings.
- 1. FAS system support methods to mount from ceiling and wall structures with 1/4", 3/8" or 5/8" threaded rod, where applicable. Select one of the following support accessories:
    - a. FASP trapeze hung supports for tray in ceiling and/or wall mounted applications. For trapeze hung installations, use a FAS Profile that is 4" longer than the tray width.
    - b. FASL supports for tray in wall-mounted applications.
    - c. Center hung, single threaded rod supports (i.e., Cablofil FASPCH) shall not be used.
  - 2. Splices including those approved for electrical continuity (bonding), as recommended by cable tray manufacturer. Select one of the following splicing methods, if applicable:
    - a. UL Classified FTSTLC Tab-Loc Connectors: No hardware required
    - b. UL Classified FTSCH: Connecting Hardware Swaged set for splicing, turns, bends and tees.
    - c. UL Classified SPLICE BAR Universal Splice Bar: Cut & bend to fit any configuration]
    - d. Preclick Splice: Bolted connection optional]
    - e. UL Classified FTSBK Splice Plate: Bolted connection
    - f. UL Classified CE 25 & CE 30 Square Splice Washers: Use with EZ BN 1/4" Nut & Bolt
    - g. UL Classified CE 40 Square Splice Washer: Use with EZ BN 1/4" to splice trays on bends, adjustable tees.
    - h. FASLock Splice: For sweeps and bends with tray 12" (300mm) and wider.
    - i. UL Classified 90 DEGREEKIT: For Tees and 90s
    - j. UL Classified RADT90 kit: For 5-1/2" radius Tees and 90s
    - k. Cable Routing Accessories:
      - l. Dropout: Bolt to tray; slotted design.
      - m. Cablexit: No additional hardware needed.
      - n. GROUND BOLT: Grounding Clamp to ground cable tray.

## 2.4 EQUIPMENT GROUNDING CONDUCTOR FUNCTION AND GROUNDING

- A. UL Classified cable trays (including painted tray) may act as Equipment Grounding Conductors.
  - 1. Use UL Classified splicing methods to ensure cable tray is electrically continuous and bonded as recommended by COOPER B-Line.
    - a. Ground cable trays at each joining section and end of continuous run.
  - 2. Test cable tray system per NFPA70B, Chapter 18 to verify grounding less than 1 ohm.
  - 3. Ground cable trays against fault current, noise, lightning, and electromagnetic interference by mounting grounding wire to each 10' cable tray section with grounding clamp. COOPER B-Line GROUND BOLT.

## PART 3 - EXECUTION

### 3.1 EXAMINATION:

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of cable trays. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install cable tray level and plumb according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
  - 1. Cutting: Field-fabricate changes in direction & elevation by cutting & bending cable tray.
    - a. Cut cable tray wires in accordance with manufacturer's instructions.
    - b. Cable tray wires must be cut with side-action bolt cutters with offset head to ensure integrity of protective galvanic layer.
    - c. Remove burrs and sharp edges from cable trays.
  - 2. Certified Installers: Cable tray installers must have successfully completed Manufacturers Certified Installer program.
  - 3. A minimum of 9-inches shall be observed between the cable supports and the finished ceiling.
  - 4. A minimum of 12-inches shall be observed above the cables and cable supports.
  - 5. A minimum of 12-inches shall be observed on one side of the cable supports.
- B. It is recommended that plumbing joints are not located above the cable tray where possible. All valves including but not limited to pressure, check, control and access, shall not be located above cable tray. Valves shall remain fully accessible for complete and functional operation from the service position.

END OF SECTION

## SECTION 270553 - IDENTIFICATION FOR COMMUNICATION SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

#### 1.2 SUMMARY

- A. This section relates to the Structured Cabling Sections of this specification.
- B. This Section includes requirements for identification of components including but not limited to the following:
  - 1. Identification labeling for cables and conductors.
  - 2. Operational or instructional signs
  - 3. Equipment labels
- C. Refer to project drawings and other Division 27 sections for additional specific identification associated with the specific items.
- D. Labeling shall be consistent. Please ensure labeling corresponds to the final room number which may be different than the Architect's number scheme on the construction documents.
- E. Comply with the TIA-606-D, "The Administration Standard for the Telecommunications Infrastructure".
- F. The Contractor shall submit, for approval by the Technology Consultant and Owner, a labeling system for the cable installation. The Owner will coordinate the exact verbiage of the labeling scheme with the successful Contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cabinets, ground bars, cables, panels and outlets. The labeling system shall designate the cable origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.
- G. All label printing shall be machine generated using indelible ink ribbons or cartridges. Self-laminating labels shall be used on cable jackets, appropriately sized to the OD of the cable, and placed within the view at the termination point on each end. Outlet, patch panel and writing block labels shall be installed on, or in the space provided on the device.

#### 1.3 SUBMITTALS

- A. Submit the following in accordance with Section 270100 Operations and Maintenance of Structured Cabling Enclosures:
  - 1. Manufacturer's data for each type of product specified.

2. Schedule of identification and nomenclature to be used for identification labels.
3. Samples of each color, lettering style and other graphic representation required for identification materials.

- B. Labeling conventions for copper and fiber optical cable and terminations shall be approved by the Owner's Rowan IRT prior to installation.

#### 1.4 QUALITY ASSURANCE

- A. All work shall be in accordance with the general principles outlined in the BICSI TDMM manual latest edition and with the TIA-526, TIA-568.2-D-1 and TIA-606-D Standards.
- B. UL Compliance: Comply with the applicable requirements of the UL Standard 969. "Marking Systems," with regards to type and size of lettering for raceways and cable labels.
- C. NEMA Compliance: Comply with applicable requirements of NEMA Standards WC-1 and WC-2 pertaining to identification of power and control conductors.
- D. Major items of equipment shall have manufacturer's name, address and catalog number on the plate securely attached in a convenient place.

#### 1.5 SUGGESTED NUMBERING AND LABELING SCHEME

- A. All labeling/color schemes for the structured cabling shall conform to the standards as set forth and confirmed by the Rowan University Rowan IRT.
- B. Workstation Cable Numbering:
1. Faceplate labeling shall be consistent with that of the other buildings on the campus. Provide labeling per Owner's directions.
  2. There shall not be any open places on the patch panel.
  3. Terminate all outlets from the same room sequentially on the same patch panel.
  4. If an outlet is added, it gets a new number that is next on the sequence even if it is on an existing faceplate.
  5. Labeling techniques: The label shall be black letters on white background. Labels must be produced by label-making equipment. The blank white label tags that are included in the faceplate hardware are to be installed with clear plastic shields in all positions on the faceplate.
- C. Workstation Cable Numbering Standard: CCC-RR-LL-PP
1. CCC = Telecom room number
  2. RR = Rack number
  3. LL = Patch panel number
  4. PP = Patch panel port position

#### 1.6 RISER CABLES

- A. Number scheme: Riser cables must be assigned specific numbers. Each shall be tagged with the building abbreviation and room number of the BET/IDF at both ends of the cable clearly shown.

- B. Labeling techniques: Each cable is to be labeled on each end within 6” of where it terminates on the cross-connect panel. Cable tags must be securely fastened to the cable sheath. Wrap around tags protected by clear polyurethane tape may be used as well. Tags must be typed and be permanent. Cable tags that appear less than permanent will not be accepted. Directly writing on the cable sheath will not suffice as proper labeling of the riser cables.

#### 1.7 UTP CABLING CROSS-CONNECT BLOCKS

- A. Numbering scheme: 25 pair cables from the Utility RJ21X blocks are terminated on blocks. Cable pairs are numbered in 25 pair increments. The first cable is numbered 1-25, the second 26-50, etc. Pair #1 is terminated on the left position of the top block. Subsequent cable pairs are terminated from left to right and from top to bottom.
- B. Labeling technique: The first label block shall read, “Cables to RJ21X blocks, 1-25”. Subsequent label blocks shall denote the same for pairs 26-50, etc. The label shall be black letters on white background. Labels must be produced by label-making equipment. Handwritten labels are not allowed.

#### 1.8 FIBER OPTIC PANELS

- A. Numbering scheme: Fiber optic cables and terminations shall be numbered and labeled per current TIA Standards. The numbering scheme denotes the cable function (campus backbone, building entrance, or intrabuilding), sheath number, and buffer tube number.
- B. Labeling techniques: A label shall be installed onto the outside of the front face of the connector housing to read “Horizontal fiber optic cables to outlets” or “Entrance/riser fiber optic cables” as appropriate. Labels must be produced by label making equipment. Handwritten labels are not permitted. Horizontal fiber optic cables shall be labeled on the label tags on the closet connector housing. Each cable terminated shall be labeled with the following information: type of fiber optic cable and outlet number. For example, a label block for a multimode horizontal fiber optic cable termination might read “MM-17”. Terminations are numbered by the outlet number, not the housing or connector panel position number. Only adapter positions that are terminated are labeled.

#### 1.9 OSP FIBER OPTIC CABLES

- A. Numbering scheme: The numbering scheme denotes the cable function (campus backbone or building entrance). Each fiber optic cable sheath shall be tagged in each BET and IDF with the number and type of strands in the sheath (i.e., 12SM/12MM) and the building name of the far end of the cable clearly shown. In each intermediate maintenance hole or hand hole each cable sheath shall be tagged with the number and type of strands in the sheath and the building name of each of the cable endpoints clearly shown.
- B. Labeling technique: Each cable is to be labeled within 36” of where it enters each BET or IDF. Cable tags may be cloth or plastic tape securely fastened to the cable sheath. Wrap around tags protected by clear polyurethane tape may be used as well. Tags must be typed or permanent. Cable tags that appear less than permanent will not be accepted. Directly writing on the cable sheath will not suffice as proper labeling. In intermediate maintenance holes and hand holes, one wrap-around cable marker shall be installed on each cable sheath. Markers shall have a clear Mylar covering reading “Fiber Optic Cable-Caution” with space for cable designation. Cable markers shall be orange in color. Other types of tags, tapes or sheath marking are not acceptable.

## 1.10 EQUIPMENT RACKS

- A. Numbering scheme: Each rack is numbered sequentially denoting the following information: BET/IDF room number, and rack number. There is no correspondence between the rack equipment and configuration (type) and the rack number. Unique rack number example:
1. 01 = Rack 1
  2. 02 = Rack 2
- B. Labeling techniques:
1. Two labels shall be installed onto the front face of each equipment rack, one at the bottom of the rack, and one at the top.
  2. All labels shall be black letters on white background.
  3. Provide engraved stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening.

## 1.11 TELECOM ROOM ELECTRICAL RECEPTACLES

- A. Each electrical receptacle in MDF/IDFs shall be labeled with the following information: room number where electrical panel is located, panel number, and circuit number. Each receptacle is to be labeled on top or front of the faceplate or outlet box. Preprinted adhesive labels or tags shall be used.

## PART 2 - PRODUCTS

### 2.1 TECHNOLOGY IDENTIFICATION PRODUCTS

- A. Cable/Conductor Identification Bands:
1. Provide Manufacturer's standard wrap-around cable/conductor markers, of size required for proper application, and numbered to show circuit identification.
- B. Equipment Labels
1. General: Provide engraved stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening.
  2. Thickness: 1/16", for units up to 20 sq. in. or 8" length; 1/8" for larger units.
- C. Lettering and Graphics
1. Coordinate names, abbreviations and other designations used in technology identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the technology systems and equipment.
  2. Fasteners for Plastic-Laminated Signs shall be self-tapping Stainless-steel-steel screws or number 10/32 Stainless-steel steel machine screws with nuts and lock washers.



3. Exception: Where specifically approved contact type permanent adhesive may be used where screws cannot or should not penetrate substrate.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application.
- B. The Contractor shall be responsible to adapt their labeling and identification system to match the existing standards of Rowan University and meet those standards to the Owner's satisfaction.
  1. The Contractor shall procure a copy of the Owner's detailed labeling & identification standards and shall follow those standards as directed.
- C. Lettering and Graphics
  1. Coordinate names, abbreviations, colors and other designations used in technology identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as reviewed in submittals and as required by standards.
- D. Install identification devices as indicated, in accordance with manufacturers written instructions.
- E. Sequence of work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

### 3.2 TECHNOLOGY ROOM IDENTIFIER

- A. The Telecommunications Rooms (Communications Distribution rooms) shall be identified with the room number as assigned by the Owner.

### 3.3 CABLE/CONDUCTOR IDENTIFICATION

- A. Apply cable/cable conductor identification on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present. Match identification with the marking system used on shop drawings, contract documents, and similar previously established identification for project's technology work.

### 3.4 OPERATIONAL SIGNS

- A. Provide instructional signs with approved legend where instructions or explanations are needed for system or equipment operation.

### 3.5 OUTLET IDENTIFICATION

- A. Label each voice and data outlet with the proper designation and provide appropriate icon.
- B. The RJ45 jacks shall have the following basic color coding:

1. Data = White

### 3.6 INSTALLATION

- A. Provide labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION

## SECTION 270800 - COMMISSIONING COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Provisions and Specification Sections, apply to this and the other sections of Division 27.
- B. This section relates to the Structured Cabling Sections of this specification.

#### 1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for the structured cabling system and campus inter-building distribution systems. It includes terminations and testing parameters. Reference individual sections for further expansion of these requirements.
- B. Codes: The cabling system installation shall comply fully with all local, county and state laws, ordinances and regulations applicable to electronic and electrical installations.
- C. The following industry standards are the basis for the structured cabling system described in this document.
  - 1. TIA-568.1-E Commercial Building Telecommunications Cabling Standard
  - 2. TIA-568.2-D Balanced Twisted Pair Cabling Components Standard
  - 3. TIA-568.3-D Optical Fiber Cabling Components Standard
  - 4. TIA-568.4-D Broadband Coaxial Cabling and Components Standard
  - 5. TIA-569-E Commercial Building Standard for Telecommunications Pathways
  - 6. TIA-606-D Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
  - 7. TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
  - 8. NFPA National Fire Protection Association
  - 9. NFPA 70 National Electric Code (NEC)
  - 10. ISO/IEC International Organization of Standards/International Electrotechnical Commission
  - 11. ISO 11801-1 Generic Cabling Requirements for Twisted Pair and Optical Fiber Cables
- D. If there is a conflict between applicable documents, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
- E. This document does not replace any code, either partially or wholly. The Contractor must be aware of local codes that may impact this project.

## PART 2 - PRODUCTS

### 2.1 QUALITY ASSURANCE PARAMETERS

- A. All work shall be performed in accordance with these guidelines, current industry testing standards, and with the test equipment manufacturer recommendations. All work shall be in accordance with the general principles outlined in the BICSI TDMM manual, latest edition. The system shall be Siemon certified through the Siemon Cabling System Warranty Program.
- B. All equipment or apparatus of any one system must be the product of one manufacturer or approved equivalent products of a number of manufacturer's that are suitable for use in a unified system.
- C. All materials and equipment for which Underwriter's Laboratories have established standards shall bear a UL label of approval.
- D. Where proprietary names are used, whether or not followed by the words "or as approved," they shall be subject to substitution only as approved by the Owner and Technology Consultant.
- E. Where the Contractor proposes substitute equipment, Contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

## PART 3 - EXECUTION

### 3.1 UTP CABLE TESTING

- A. Riser and campus distribution cable testing: Each cable pair within all UTP riser cables shall be tested for continuity to ensure conductors are terminated in proper sequence, with correct polarity (tip and ring), and without conductor-to-conductor shorts, conductor-to-ground shorts, or opens.
- B. Horizontal cable testing: All UTP station cables shall be tested to prove compliance with the current industry standard, TIA-568.2-D-1 Part 2: Balanced Twisted Pair Cabling Components, Addendum – Transmission Performance Specifications for 4-pair 100  $\Omega$  CAT6A Cabling and any subsequent addenda. Permanent Link tests are the only acceptable test format for testing Category 6 cabling or Channel tests are the only acceptable test format for testing CAT6A cabling.
- C. Horizontal cable testing equipment: The testing of UTP station cables shall be performed using the recommended test equipment specifically designed to test cables for all parameters from 0 – 500 MHz. Testers shall be loaded with the most recent test values per the above referenced standard. The Contractor will be required to provide current calibration and firmware release for the test equipment to be used.
- D. The field test equipment shall meet the requirements of ANSI/TIA-568-D including applicable Technical Service Bulletins and amendments. The appropriate level III tester shall be used to verify CAT6A cabling systems.

### 3.2 FIBER OPTIC CABLE TESTING

#### A. Inter-building cable testing requirements:

1. Bi-directional direction.
  - a. Test single-mode strands at 1310 nm and 1550 nm.
  - b. Use optical time domain reflectometer (OTDR) and power meter for tests.
  - c. Record the following at the above frequencies:
  - d. Signature trace
  - e. Length
  - f. Polarity
  - g. End to end attenuation
2. Fiber optic cables: Test results for fiber optic cables shall consist of the measured attenuation, the maximum attenuation allowed per these guidelines, and whether the test passed or failed for each fiber optic cable link.
3. Provide test report and include as a minimum the following information for all cables:
  - a. Fiber cable number
  - b. Fiber length.
  - c. Attenuation (loss in dB)
  - d. Test date
  - e. Tester make and model number
  - f. Tester calibration date
4. Maximum optical attenuation per connector pair for singlemode fiber connectors shall be .05 dB or less when measured at 1310/1550 nm in accordance with ANSI/TIA-526-7, Method B. Reflection shall be  $\geq 45$ dB.
5. Fluke LinkWare format on CD or approved format.

### 3.3 TEST RESULTS

A. Prior to acceptance, the Contractor shall submit a copy of all applicable test results to the Owner/Technology Consultant in both electronic (file) and paper form.

B. CAT6A cables: The test results submitted for CAT6A cables shall be recorded by Fluke LinkWare or approved format on CD and include the following:

1. Graphical/numerical data. Both graphical data plots and numerical data are required for the following test parameters:
  - a. NEXT
  - b. PS NEXT
  - c. ELFEXT
  - d. PS ELFEXT
  - e. Attenuation
  - f. Return loss
2. Numerical data. Numerical data only is required for the following test parameters:
  - a. Propagation delay
  - b. Delay skew
  - c. Resistance
3. The CAT6A Horizontal Cable Certification reports shall have complete testing of Permanent Link at frequency increments up to 500 MHz as indicated in TIA-568-D and shall include the following:
  - a. Cable/Faceplate Number - matching faceplate numbers on patch panels
  - b. Test Date
  - c. Cable Length
  - d. Wire-Map
  - e. Network Tests for 100BASE-TX and 1000BASE-T

- f. Attenuation
  - g. Near End Crosstalk (NEXT)
  - h. Power-sum NEXT (PS-NEXT)
  - i. Attenuation to Cross Talk Ratio (ACR)
  - j. Power-sum Attenuation to Crosstalk Ratio (PS-ACR)
  - k. Equal Level Far End Crosstalk (ELFEXT)
  - l. Power-sum Equal Level Far End Crosstalk (PS-ELFEXT)
  - m. Return Loss
  - n. Propagation Delay
  - o. Delay Skew
  - p. Signal to Noise Ratio
4. Testing of horizontal cabling shall not be performed on test equipment with marginal pass/fail notification disabled. If the tester is capable of indicating tests that pass with a measured value closer to the limit than the guaranteed accuracy of the tester, the test result shall be marked (typically as Pass\* or Fail\*).
5. Marginal pass results will not be accepted. Contractor shall correct issue and retest at no expense to the Owner.

### 3.4 SYSTEM DOCUMENTATION

- A. When all work has been completed and before final acceptance, the Contractor shall furnish to the Technology Consultant a complete set of documents that clearly represent all contract work “as-built.” This shall be inclusive of all test results and drawings. The Contractor is responsible for assuring the accuracy of the As-Built documentation.
- B. The Contractor shall submit, within forty (40) working days of the completion of each phase, three (3) full sets of As-Built documentation to the Technology Consultant for review. Prior to delivery, each document section and each drawing shall be signed and dated by the Contractor’s project manager attesting to the accuracy of the as-built documents.
- C. Electronic drawing files must conform to project drawing standards. The As-Built drawings shall include at minimum equipment locations, cable routes and outlet locations, and clearly show any deviations from the Contract Documents.
- D. The Contractor shall provide, in the MDF, a full-size laminated or similarly framed copy of the drawing which clearly provides an “in-room” roadmap of the voice/data drops that are served from within that space, respectively. The final product shall be coordinated with the Rowan IRT staff so as to follow Owner standards.
- E. Digital drawing files may be provided to the Contractor at no cost for use in the development of Shop Drawings or As-Built drawings under separate agreement between Contractor and Consultant.
- F. Test printouts and electronic documentation generated for each cable by the wire (or fiber) shall be submitted as part of the documentation package. Provide the documents in mutually acceptable format.
- G. The As-Built drawings shall include outlet locations. Their sequential number, as defined elsewhere in this document, shall identify outlet locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. These documents shall be modified accordingly by the Contractor to denote as-built information as defined above and returned to the Technology Consultant.

- H. The Technology Consultant may request that a 5% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Architect or Technology Consultant, including a 100% re-test. This re-test shall be at no additional cost to the Owner.
- I. Test Results documentation shall be clearly marked on the outside front cover with the words "Project Test Documentation," "Campbell Library" and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, and reference setup. The test equipment name, manufacturer, model number, serial number, software version and calibration date shall also be provided at the end of the document. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
- J. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

END OF SECTION

## SECTION 271100 - COMMUNICATIONS ROOMS EQUIPMENT FITTINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Cable management
  - 2. Surge protection for copper cables
  - 3. Floor-standing equipment racks
  - 4. Mounting of Owner-furnished equipment in equipment racks
  - 5. Rack mounted power protection and power strips
  - 6. Terminal blocks and patch panels
- B. Refer to following Specification Sections:
  - 1. Division 6 Section "Rough Carpentry" for wood framing and blocking for installation of wall-mounted equipment racks.
  - 2. Division 7 Sections for fire-stopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
  - 3. Division 26 Sections for supports, anchors, identification products, electrical service and connections.
- C. Provide cabinets and racks in accordance with the Contract Documents. Where conflicting data is indicated, verify mounting and equipment requirements prior to ordering.
- D. This section contains specific parts selected by Owner and Technology Consultant. In the event that the parts specified are not available, Owner and Technology Consultant shall be contacted to specify replacements.

#### 1.3 COORDINATION

- A. This Contractor shall be responsible for all coordination with the general and electrical contractor and data and voice vendors to provide a complete operational system.
- B. Coordinate layout and installation of equipment racks with adjacent construction.

#### 1.4 SUBMITTALS

- A. Product Data: For copper protection devices, cabinets and equipment racks, termination blocks and patch panels, cable management devices, and power strips.



1. Where multiple products are shown on one cut sheet, circle product to be used.
- B. Shop Drawings: Show fabrication and installation details of components for cabinets, equipment racks, and their associated parts and pieces to make a complete system.
- C. Show rack elevations for review by the Owner and Technology Consultant.
- D. Allow sufficient time in project scheduling for Owner and Technology Consultant review.
- E. Submittals shall be checked by the supplier and made as complete systems including all required accessories and any special tools.
- F. Manufacturer's installation and maintenance instructions.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of enclosure through one source from a single manufacturer.
- B. All work shall be in accordance with the latest edition of all applicable State, and Federal regulations and codes. Further, all work shall also be in accordance with TIA Standards, the BICSI TDMM manual, latest edition and with the manufacturer's recommendations.

#### 1.6 SEQUENCING AND SCHEDULING

- A. Sequence all work to support the installation of the structured cabling system, electrical work and all cable tray systems installation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available manufacturers are listed in subparagraphs for each Part 2 article below.
- B. Proposed substitutions shall be submitted WITH THE BID and must be approved by the Owner and Technology Consultant.
- C. Requests for substitution are only permitted for materials specified with an "or approved equivalent" clause or other language of same effect in the Contract Documents.

#### 2.2 SURGE PROTECTION

- A. Shall be wall-mounted 110-type.
  1. Use Ditek, Part #DTK-110C6APOE or approved equivalent.
- B. Protection modules are to be solid state with automatic reset.

## 2.3 RACKS

- A. Floor Distribution Frame: for rack mounted installations in Main Distribution Frame (MDF) and Intermediate Distribution Frame (IDF) Rooms, the installer shall use a 7-foot high 19-inch equipment rack.
- B. The racks shall:
  - 1. Be made by an ISO 9001 and 14001 Certified Manufacturer.
  - 2. Have cable access holes on side rails, which allow cables to be routed between adjacent racks.
  - 3. Have standard 19-inch EIA/ECA-310 mounting holes having a full 45 RU on front and back of rails.
  - 4. The racks shall have floor mounting holes and a ground lug for 0–6-gauge ground cable provided.
  - 5. Use Chatsworth Products, Part #55053-103. Ensure product submittal includes all accessories and ensures system compatibility.

## 2.4 VERTICAL CABLE MANAGERS

- A. The racks shall have vertical cable management channels 6" W x 6.38" D x 7'H. Channels will be located between racks and on the end of each row. The channel shall include cable retainers, which can be hinged left or right and be located in any position along the channel.
- B. The vertical cable managers shall utilize black grommets at all cable openings, including unused cable openings.
  - 1. CPI, Part #32620-705
- C. Ensure product submittal includes all accessories and ensures system compatibility.

## 2.5 RACK MOUNT POWER STRIP

- A. Provide rack-mounted power strips 1 RU in height with 8 outlets and 10' cord.
  - 1. APC AP9671A
    - a. Connect downstream of the UPS.
  - 2. APC AP8683
    - a. Connect to "street" power.
  - 3. Provide one of each per rack.

## 2.6 CABLE LADDER RUNWAY

- A. Cable runway shall be included as shown and as required for cable routing and overhead seismic restraint.
- B. Provide cable runway radius drops, pathway dividers, junctions, splices, supports, and all necessary appurtenances for a complete installation.
- C. Cable runway mounted over racks shall be designed specifically for use over 19" wide racks and vertical cable managers wherein the runway cross-members are spaced to align over the vertical cable channels.

- D. Use CPI or approved manufacturers:
  - 1. CPI Part #31472-718 where 18" ladder is indicated on drawings.
  - 2. CPI Part #31472-724 where 24" ladder is indicated on drawings.
  
- E. Cable runway for telecommunication room usage other than specified above shall be:
  - 1. CPI Part #10250-718 where 18" ladder is indicated on drawings.
  - 2. CPI Part #10250-724 where 24" ladder is indicated on drawings.

## PART 3 - EXECUTION

### 3.1 LIGHTNING PROTECTION

- A. All copper cables, either multi-pair or coaxial, are to be terminated on lightning protection as soon as practical upon entering the building.
- B. All pairs of twisted pair copper cable which extends outside of the building envelope are to be protected to lightning protection blocks.
- C. Lightning Protection Blocks are to be bonded to the nearest building or electrical ground or to a dedicated grounding rod.

### 3.2 RACKS

- A. Preparation
  - 1. Coordinate requirements for riser bases, raised floor riser feet, anchors, bracing, and blocking to ensure adequate means for installation of racks/cabinets.
  - 2. Coordinate requirements for electrical cable pathways from overhead cable trays and management systems.
  
- B. Installation
  - 1. Install racks in compliance with manufacturer's written instructions and shop drawings.
  - 2. Floor-standing racks/cabinets in the telecommunication rooms shall be securely attached to the concrete floor using minimum 3/8" in diameter hardware utilizing an approved length.
    - a. Contractor shall abide by any regional seismic requirements for rack type and installation.
  - 3. Install equipment racks at locations and heights indicated on Drawings. Rows of racks/cabinets shall be placed with a 36-inch (minimum) clearance from the walls on all sides of the rack, unless otherwise indicated on Drawings. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks/cabinets. Where racks/cabinets are shown side by side, securely connect together using manufacturer's ganging hardware to provide a stable system. Supply all miscellaneous parts and pieces to make a complete system.
  - 4. Rack and runway installation shall comply with local seismic bracing requirements.
  - 5. All racks/cabinets shall be grounded to the ground bus bar in accordance with the drawings and other Sections of this document.
  - 6. Rack mount screws not used for installing patch panels, keys and other hardware shall be bagged and left with the rack upon completion of the installation.

7. Horizontal wire managers shall be installed between patch panels as described in Section 271600. The Contractor shall provide an equal number of wire managers in the electronics racks as was required for the patch panels and install them in the same configuration for the Owner to use with their electronics.
8. Vertical cable managers shall be installed on both sides (left and right) of each rack in the telecommunications rooms.
9. Horizontal cable jumper tray shall be in the uppermost position and have the radius section adjusted to transition optical fiber to the vertical cable channel.

### 3.3 OWNER FURNISHED EQUIPMENT

A. Owner furnished equipment in the Campbell Library and installed the contractor includes:

1. Network Switches
2. Wireless Access Points
3. VoIP Telephones

END OF SECTION

## SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.
- B. This section is inclusive to all Division 27 sections.
- C. Division 7 Sections for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.

#### 1.2 DRAWINGS

- A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.
- B. In all details, the work shall be subject to the Owner's direction and approval. All work shall conform to its surroundings in best possible manner.

#### 1.3 SCOPE OF WORK

- A. General
  - 1. This project includes the installation of fiber and copper cables.
  - 2. All UTP terminations must follow 568B wiring schematic.
  - 3. All copper cabling shall be manufactured by Siemon.
  - 4. All fiber optic cabling shall be manufactured by Siemon.
- B. The Contractor shall provide a complete structured cabling system that will accommodate voice, and data for all rooms defined in scope.
- C. Intra-Building Backbone Cabling
  - 1. Fiber Optic Cabling:
    - a. Install one (1) new 24-strand single-mode cable from the Campbell Library MDF 112 to the each IDF.
    - b. Terminate fiber in new rack mounted fiber distribution shelves with LC panels and connectors in Campbell Library MDF 112 and all IDFs as indicated on the drawings.
  - 2. Coaxial Cabling
    - a. Install one (1) new RG-11 riser rated coaxial copper cable from the MDF-112 to each IDF.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Available manufacturers are listed in subparagraphs for each Part article below.
- B. Proposed substitutions shall be submitted WITH THE BID and must be approved by the Owner and Technology Consultant.
- C. Requests for substitutions are only permitted for materials with an “or approved equivalent” clause or other language of the same effect in the “Contract Documents.”

### 2.2 BACKBONE CABLING

- A. Cables allowed for use in the intra-building backbone include fiber optic and coaxial cables. The cable shall support voice, data, and imaging applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation.
- B. All UTP cables shall conform to ANSI/TIA-568-D Commercial Building Telecommunications Cabling Standard and ISO/IEC 11801 (International) Generic Cabling for Customer Premises standard.
- C. Campus outside plant copper cables allowed for use in the backbone shall:
  - 1. Be 25-pair 100Ω cable.
  - 2. Be General Cable, Part #2131505
  - 3. Be appropriate for the environment in which it is installed.
- D. Single-Mode 24-fiber shall be:
  - 1. Siemon MIC Tight-Buffered Interlocking Armored Cable, Plenum, 24F, single-mode optical fiber cable, OFNP Part No. 024E88-33131-A3 approved equal. (OS2
- E. Coaxial Cable
  - 1. Quad shield, 100% shielding, tested to 3000 kHz.
  - 2. Cable shall be rated for use in return air plenums (CMP)
  - 3. Provide Belden 7999AP or approved equal.
  - 4. Terminate each end of the cable with “F” type compression connector appropriate for the cable.
    - a. Use Belden 716SNS1P11HQ or approved equal.
- F. 48-strand (2U) rack mountable optical fiber connector housing
  - 1. Strain relief options: compression glands, or internal clips and entrapment of yarn based impact resistance.
  - 2. Capable to house twelve and four respectively, adapter panels and/or splice trays and a cable loop.
  - 3. Shall have cable management rings or guides shall be provided to allow individual elements to be stored in the panel without crushing, bending or straining each element.
  - 4. Shall be able to store fiber reserve within the parameter/requirement of the fiber cable manufacturer for minimum bending radius.

5. Provide armored cable grounding kits and any accessory products related to the optical fiber termination shelves to provide a complete and functional infrastructure system.
6. Provide bulkhead adapters with ceramic alignment sleeves:
7. 12-fiber duplex single-mode LC adapter panel
8. Connector type to be confirmed with the owner before ordering
9. Provide pigtail and splice trays/cassettes with fiber and cable management.
10. Description:
  - a. Siemon 4RU connector housing for the MDF room
  - b. Siemon 2RU connector housings for each IDF rooms
  - c. Siemon 24-fiber single-mode pigtail splice cassette with duplex LC connectors
  - d. Siemon splice cassette
  - e. Siemon slack cassette
  - f. 24-strand SM2 fusion splice

### PART 3 - EXECUTION

#### 3.1 SITE SURVEY

- A. Prior to placing any cable pathways or cable, the Contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.

#### 3.2 PHYSICAL INSTALLATION

- A. Industry requirements: The following installation, documentation, component and system industry specifications shall be met or exceeded:
  1. ANSI/TIA-526-7 “Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant”.
  2. ANSI/TIA-526-14A “Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant”.
  3. ANSI/TIA-568.1-D and addenda “Commercial Building Telecommunications Cabling Standard - General Requirements”.
  4. ANSI/TIA-568.2-D and addenda “Commercial Building Telecommunications Cabling Standard - Balanced Twisted Pair Cabling and Components Standard”.
  5. ANSI/TIA-568.3-D and addenda “Commercial Building Telecommunications Cabling Standard - Optical Fiber Cabling and Components Standard”.
  6. ANSI/TIA-568.4-D and addenda “Commercial Building Telecommunications Cabling Standard - Broadband Coaxial Cabling and Components Standard”.
  7. ANSI/TIA-569-E and addenda “Commercial Building Standard for Telecommunications Pathways and Spaces”.
  8. ANSI/TIA-606-D and addenda “Administration Standard for the Telecommunications Infrastructure of Commercial Buildings”.
  9. TIA-607-D and addenda “Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises”.
  10. IEC/TR3 61000-5-2 - Ed. 1.0 and amendments “Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and cabling”.
  11. ISO/IEC 11801:2000 Ed1.2 and amendments “Information technology - Generic cabling for customer premises”.
  12. CENELEC EN 50173:2000 and amendments “Information Technology - Generic cabling systems.”

B. Cable Pathways

1. Pathways shall be designed and installed to meet applicable local and national building and electrical codes or regulations.
2. Grounding and bonding of pathways shall comply with applicable codes and regulations.
3. Pathways shall not have exposed sharp edges that may come into contact with telecommunications cables.
4. The number of cables placed in a pathway shall not exceed manufacture specifications, nor will the geometric shape of a cable be affected.

C. Cable Routing

1. In open ceiling cabling, cable supports shall be provided by means that is structurally independent of the suspended ceiling, its framework, or supports. These supports shall be spaced no more than 1.5m (5ft) apart.
2. Telecommunications pathways, spaces and metallic cables, which run parallel with electric power or lighting, which is less than or equal to 480 Vrms, shall be installed with a minimum clearance of 50mm (2in).
3. The installation of telecommunications cabling shall maintain a minimum clearance of 3m (10ft) from power cables in excess of 480 Vrms.
4. No telecommunications cross-connects shall be physically located within 6m (20ft) of electrical distribution panels, step down devices, or transformers, which carry voltages in excess of 480 Vrms.
5. In the telecommunications rooms where cable trays or cable racking are used, the Contractor shall provide appropriate means of cable management such as reusable color-coded hook and loop cable managers (ties) to create a neat appearance and practical installation.
6. In a false ceiling environment, a minimum of 9-inches shall be observed between the cable supports and the false ceiling.
7. Continuous conduit runs installed by the Contractor should not exceed 30.5m (100ft) or contain more than two (2) 90-degree bends without utilizing appropriately sized pull boxes.
8. Maximum conduit pathway capacity shall not exceed a 40% fill. However, perimeter fill is limited to 60% fill for move and changes.

D. Backbone pathways shall:

1. Be installed or selected such that the minimum bend radius of backbone cables is kept within manufacturer specifications both during and after installation.
2. Have adequate riser sleeve/slot space available with the ability to ingress the area at a later date in all Telecommunications Rooms, such that no drilling of additional sleeves/slots is necessary.

E. Pulling Tension

1. The maximum cable pulling tensions shall not exceed manufacturer's specifications.

F. Bend Radius

1. The maximum cable bend radii shall not exceed manufacturer's specifications.
2. In spaces with UTP cable terminations, the maximum bend radius for 4-pair cable shall not exceed four times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.
3. During the actual installation, bend radius on 4-pair cable shall not exceed eight times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.



G. Slack/Service Loop

1. In telecommunications rooms a minimum of 6m (20ft) of slack should be left for all cable types. This slack must be neatly managed on plywood walls fields in locations as shown on drawings.

H. Cable Wraps

1. Hook and loop cable managers should be used in the telecommunications rooms where reconfiguration of cables and terminations may be frequent.

I. Grounding

1. Grounding and bonding shall be done per applicable codes and standards.

J. Cable Protection

1. Cables shall not be exposed to paint, paint remover, water, or any liquids which may degrade the performance of the cable, void the manufacturer's warranty, alter the flame and/or smoke characteristics of the cable, or obscure the flame rating designations printed on the jacket. Cables exposed to paint, paint remover, water, or any liquid shall be replaced by the Contractor.

K. Fire Protection

1. Properly installed firestop systems shall be installed to prevent or retard the spread of fire, smoke, water, and gases through the building. This requirement applies to openings designed for telecommunications use that may or may not be penetrated by cables, wires, or raceways.
2. Fire stops shall comply with all applicable codes.

L. Workmanship

1. All work shall be done in a workman like fashion of the highest standards in the telecommunications industry. All equipment and materials are to be installed in a neat and secure manner, while cables are to be properly dressed. Workers must clean any debris and trash at the close of each workday.

END OF SECTION

## SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. This section is inclusive to all Division 27 sections.

#### 1.2 DRAWINGS

- A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.
- B. All work shall be subject to the Owner's direction and approval.

#### 1.3 SUBMITTALS

- A. The Contractor shall provide product submittals for all system components as defined in Part 2 of this specification section. These components shall include all structured cabling and associated structured cabling components. The selected Contractor will allow sufficient time in project scheduling for client and review by the Architect's Technology Consultant.

#### 1.4 SCOPE OF WORK

- A. The campus network cabling solution shall be based upon structured cabling system components manufactured by Siemon and allied manufacturers. This may include but not be limited to cable management, faceplates, copper and fiber modules, patch panels, racks, 110-type blocks, patch cords, labels and grounding hardware.
- B. All UTP terminations shall follow 568B wiring schematic.
- C. All copper cabling shall be manufactured by Siemon.
- D. The installed system shall meet all the requirements necessary to achieve certification for the Siemon Warranty Program.
- E. The Contractor shall provide a complete structured cabling system that will support voice, data, security and video applications for the building.
- F. Contractor shall provide outlets as identified in this specification or indicated on the drawings.

## PART 2 - PRODUCTS

### 2.1 HORIZONTAL CABLING

#### A. General

1. Available manufacturers are listed in subparagraphs for each PART 2 article below.
2. Proposed substitutions shall be submitted WITH THE BID and must be reviewed by the Owner and Technology Consultant.
3. Requests for substitutions are only permitted for materials specified with an “or approved equivalent” clause or other language of the same effect in the Contract Documents.

B. The Horizontal Subsystem is the portion of the telecommunications cabling system that extends from the work area telecommunications outlet/connector to the horizontal cross-connect in the telecommunications room. It consists of the telecommunications outlet/connector, the horizontal cable and the patch panel or termination block in the telecommunications room.

#### C. Cable Types

1. All telecommunications cables shall conform to ANSI/TIA 568-D Commercial Building Telecommunications Cabling Standard (latest amendment including all applicable addenda) and ISO/IEC 11801 (International) Generic Cabling for Customer Premises standard.
2. Be appropriate for the environment in which it is installed.
  - a. All cables running below slab on grade shall be outdoor rated.
3. Be plenum-rated, yellow jacketed with “Rowan University” and the date of manufacture printed on the jacket.
4. The copper 4-pair UTP CAT6A cables shall meet the following specifications:
  - a. Attenuation
  - b. Near End Crosstalk (NEXT)
  - c. Power Sum Near Crosstalk (PSNEXT)
  - d. Equal Level Far-End Crosstalk (ELFEXT)
  - e. Power Sum Equal Level Far-End Crosstalk (PSELFEXT)
  - f. Return Loss
  - g. Propagation Delay (ANSI/TIA-568-D1)
  - h. Delay Skew (ANSI/TIA-568-D1)
  - i. Attenuation to Crosstalk Ratio (ACR)
  - j. Power Sum Attenuation to Crosstalk Ratio (PSACR)
  - k. Near End Crosstalk (NEXT) Loss
  - l. Near End Crosstalk (NEXT) Loss
5. Cable shall be:
  - a. Siemon Cat6A, yellow, Part # U6P4A5-05R1ARU. No substitutions will be considered.

### 2.2 PATCH PANELS

#### A. Patch panels shall:

1. Support CAT6A performance levels.
2. Be flat to minimize or eliminate the use of horizontal cable managers to feed the patch panels.
3. Be 48-port capacity and 2RU in height.

4. Be backwards compatible to allow lowering the performing categories of cables or connecting hardware to operate to their full capacity.
5. Support industry standards for T568A or T568B wiring options on each individual outlet.
6. Be made by an ISO 9001 and 14001 Certified Manufacturer.
7. Be Siemon Max, Part # MX-PNL-48.

## 2.3 INFORMATION OUTLETS

- A. All CAT6A high density information outlets for 100Ω 22-24AWG copper cable shall:

1. Be available in black, white, gray, ivory, light ivory, blue and red.
2. Be 8-position /8-conductor with coherent pairing of IDC pins.
3. Utilize center tuned technology with optimized pair balance design and linear crosstalk response to address applications up to 500 MHz.
4. Support industry standards for T568A or T568B wiring options on each individual outlet.
5. Allow installation from the front or the rear of the faceplate and allow for the jack to pass through the faceplate without re-termination.
6. Provide color-coded, slide-in icons available for circuit identification.
7. Be constructed of high impact, flame-retardant thermoplastic.
8. Be made by an ISO 9001 and 14001 Certified Manufacturer.
9. Be ANSI/TIA 568-D.2-1 and ISO/IEC 11801 CAT6A compliant.
10. Be UL VERIFIED (or equivalent) for TIA CAT6A electrical performance.
11. Be UL LISTED 1863 and CUL approved.
12. Be Siemon Z-Max, Part #Z6A-02 (white).

## 2.4 FACEPLATES

- A. Face plates shall be:

1. Siemon 10G Max, Part # 10GMX-FPS0x-02 (white) for single gang applications.
2. Siemon 10G Max, Part # 10GMX-FPD0x-02 (white) for double gang applications.
3. Siemon Stainless-steel Steel, Part # MX-WP-Z6A-SS for wall telephone applications.

- B. Blank inserts shall be used in unused faceplate openings.

1. Siemon, Part #MX-BL-02 (white).

## PART 3 - EXECUTION

### 3.1 SITE SURVEY

- A. Prior to placing any cable pathways or cable, the Contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.

### 3.2 PHYSICAL INSTALLATION

- A. Industry requirements: The following installation, documentation, component, and system industry specifications shall be met or exceeded:

1. ANSI/TIA-526-7 “Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant”.
2. ANSI/TIA-526-14A “Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant”.
3. ANSI/TIA-568.1-D and addenda “Commercial Building Telecommunications Cabling Standard - General Requirements”.
4. ANSI/TIA-568.2-D and addenda “Commercial Building Telecommunications Cabling Standard - Balanced Twisted-Pair”.
5. ANSI/TIA-568.3-D and addenda “Commercial Building Telecommunications Cabling Standard - Optical Fiber Cabling and Components Standard”.
6. ANSI/TIA-568.4-D and addenda “Commercial Building Telecommunications Cabling Standard - Broadband Coaxial Cabling and Components Standard”.
7. ANSI/TIA-569-E and addenda “Commercial Building Standard for Telecommunications Pathways and Spaces”.
8. ANSI/TIA-606-D and addenda “Administration Standard for the Telecommunications Infrastructure of Commercial Buildings”.
9. TIA-607-D and addenda “Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises”.
10. IEC/TR3 61000-5-2 - Ed. 1.0 and amendments “Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and cabling”.
11. ISO/IEC 11801:2000 Ed1.2 and amendments “Information technology - Generic cabling for customer premises”.
12. CENELEC EN 50173:2000 and amendments “Information Technology - Generic cabling systems.”

#### B. Cable Pathways

1. Pathways shall be designed and installed to meet applicable local and national building and electrical codes or regulations.
2. Grounding and bonding of pathways shall comply with applicable codes and regulations.
3. Pathways shall not have exposed sharp edges that may come into contact with telecommunications cables.
4. The number of cables placed in a pathway shall not exceed manufacture specifications, nor will the geometric shape of a cable be affected.

#### C. Cable Routing

1. All horizontal cables, regardless of media type, shall not exceed 90 meters (295 ft.) from the telecommunications outlets in the work area to the horizontal cross-connect.
2. The combined length of jumpers or patch cords and equipment cables in the telecommunications room/closet and the work area shall not exceed 10 meters (33 ft.) unless used in conjunction with a multi-user telecommunications outlet.
3. Two horizontal cables shall be routed to each work area. At least one cable connected to an information outlet shall be 4-pair, 100Ω unshielded twisted-pair (UTP).
4. Horizontal pathways shall be installed or selected such that minimum bend radius of horizontal cables is kept within the manufacturer’s specification both during and after the installation.
5. In open ceiling cabling, cable supports shall be provided by means that is structurally independent of the suspended ceiling, its framework, or supports. These supports shall be spaced no more than 1.5m (5ft) apart.
6. Telecommunications pathways, spaces and metallic cables, which run parallel with electric power or lighting, which is less than or equal to 480 Vrms, shall be installed with a minimum clearance of 50mm (2in).
7. The installation of telecommunications cabling shall maintain a minimum clearance of 3m (10ft) from power cables in excess of 480 Vrms.

8. No telecommunications cross-connects shall be physically located within 6m (20ft) of electrical distribution panels, step down devices, or transformers, which carry voltages in excess of 480 Vrms.
9. For voice or data applications, 4-pair UTP or fiber optic cables shall be run using a star topology from the telecommunications room serving that floor, to every individual information outlet.
10. The Contractor shall observe the bending radius and pulling strength requirements of the 4-pair UTP and fiber optic cable during handling and installation.
11. In the telecommunication room where cable trays or cable racking are used, the Contractor shall provide appropriate means of cable management such as reusable color-coded hook and loop.
12. In a false ceiling environment, a minimum of 9-inches shall be observed between the cable supports and the false ceiling.
13. Continuous conduit runs installed by the Contractor should not exceed 30.5m (100ft) or contain more than two (2) 90-degree bends without utilizing appropriately sized pull boxes.
14. Maximum conduit pathway capacity shall not exceed a 40% fill. However, perimeter fill is limited to 60% fill for move and changes.
15. Cables shall be bundled in groups of 24 cables maximum.

D. Work Area terminations:

1. All UTP cables wired to the telecommunications outlet/connector shall have 4-pairs terminated in eight-position modular outlets in the work area. All pairs shall be terminated.
2. The telecommunications outlet/connector shall be securely mounted at planned locations.
3. The height of the telecommunications faceplates shall be applicable to codes and regulations.

E. Pulling Tension

1. The maximum cable pulling tensions shall not exceed manufacturer's specifications.

F. Bend Radius

1. The maximum cable bend radii shall not exceed manufacturer's specifications.
2. In spaces with UTP cable terminations, the maximum bend radius for 4-pair cable shall not exceed four times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.
3. During the actual installation, bend radius on 4-pair cable shall not exceed eight times the outside diameter of the cable and ten times for multi-pair cable. This shall be done unless this violates manufacturer specifications.

G. Slack/Service Loop

1. In telecommunications rooms a minimum of 6m (20ft) of slack should be left for all cable types. This slack must be neatly managed on plywood walls fields in locations as shown on drawings.

H. Cable Wraps

1. Hook and loop cable managers should be used in the telecommunications rooms where reconfiguration of cables and terminations may be frequent.

I. Grounding

1. Grounding and bonding shall be done per applicable codes and standards.

J. Cable Protection

1. Cables shall not be exposed to paint, paint remover, water, or any liquids which may degrade the performance of the cable, void the manufacturer's warranty, alter the flame and/or smoke characteristics of the cable, or obscure the flame rating designations printed on the jacket. Cables exposed to paint, paint remover, water, or any liquid shall be replaced by the Contractor.

K. Fire Protection

1. Properly installed firestop systems shall be installed to prevent or retard the spread of fire, smoke, water, and gases through the building. This requirement applies to openings designed for telecommunications use that may or may not be penetrated by cables, wires, or raceways.
2. Fire stops shall comply with all applicable codes.

L. Workmanship

1. All work shall be done in a workman like fashion of the highest standards in the telecommunications industry. All equipment and materials are to be installed in a neat and secure manner, while cables are to be properly dressed. Workers must clean any debris and trash at the close of each workday.

END OF SECTION

## SECTION 271600 - COMMUNICATIONS CONNECTING CORDS, DEVICES, AND ADAPTERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 27.
- B. This section is inclusive to all Division 27 sections.
- C. Division 7 Sections for fire-stopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.

#### 1.2 DRAWINGS

- A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.
- B. In all details, the work shall be subject to the Owner's direction and approval. All work shall conform to its surroundings in best possible manner.

#### 1.3 SCOPE OF WORK

- A. General
  - 1. This project includes the supply of patch cords, adaptors and devices.
  - 2. All UTP terminations must follow 568B wiring schematic.
  - 3. Contractor shall install patch cords between switches and patch panels per Owner direction.

#### 1.4 SUBMITTALS

- A. The Contractor shall provide product submittals for all system components as defined in Part 2 of this specification section. These components shall include all communications connection cords, devices and associated components. The selected Contractor will allow sufficient time in project scheduling for client and review by the Architect's Technology Consultant

### PART 2 - PRODUCTS

#### 2.1 CORDS, DEVICES, AND ADAPTORS

- A. This portion of the communications system includes termination of copper and fiber cables using modules and adaptors, faceplates, and patch cords.



## 2.2 PATCH CORDS

A. Telecommunication Room patch cords shall meet or exceed the following criteria:

1. CAT6A, modular equipment cords shall:
  - a. Be factory made.
  - b. Be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted pairs within a flame-retardant jacket.
  - c. Be equipped with modular 8-position (RJ45 style) plugs on both ends, wired straight through with standards compliant wiring.
  - d. Be backwards compatible with lower performing categories.
  - e. Use modular plugs which exceed FCC CFR 47 part 68 subpart F and IEC 60603-7 specifications and have 50 micro inches minimum of gold plating over nickel contacts.
  - f. Be resistant to corrosion from humidity, extreme temperatures, and airborne contaminants.
  - g. Be available in any custom length and standard lengths of 0.9, 1.5, 2.1, 3.1, 4.6, 6.1, 7.6 meters (3, 5, 7, 10, 14, 20, and 25 feet).
  - h. Be made by an ISO 9001 and 14001 Certified Manufacturer.
  - i. Electrical Specifications:
    - 1) Have a DC resistance per lead:  $9.38 \Omega / 100 \text{ m}$  maximum.
    - 2) Have input impedance without averaging:  $100 \Omega + 15\%$  from 1 to 100 MHz, +  $22\%$  from 100 to 200 MHz and +  $32\%$  from 200 to 250 MHz.
  - j. Be 100% transmission tested with laboratory grade network analyzers for proper performance up to 500 MHz. Vendor shall guarantee cords are compatible with CAT6A Permanent Link.
  - k. Be UL VERIFIED (or equivalent) for TIA CAT6A electrical performance.
  - l. Be UL LISTED 1863 and CUL C22.2 approved.
  - m. Quantities shall be based on the total number of switch ports provided by the Owner, both active and inactive.
  - n. Supply 110% of the cords 1' Length – Green.

## 2.3 REFERENCE PARTS

A. Siemon #BP6A-01-07 Blade Patch Cord – 1' Length – Green

PART 3 - EXECUTION – NOT USED

END OF SECTION

## SECTION 280000 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 28.
- B. This section is inclusive to all Division 28 sections.
- C. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27.

#### 1.2 SUMMARY

- A. This project consists of providing a complete Electronic Safety and Security System for the Campbell Library on the campus of Rowan University. The electronic safety and security system includes access control, intrusion detection, surveillance, and emergency phone locations as shown on the drawings and will be connected to the campus headend.
- B. This Section includes general administrative and procedural requirements for the electronic safety and security systems. It includes Contractor qualifications, terminations and testing parameters. Reference individual sections for further expansion of these requirements.
- C. Permits, Inspections, Codes and Regulatory References
  - 1. General: Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract and shall submit approval certificates to the Technology Consultant.
  - 2. Codes: The cabling system installation shall comply fully with all local, county and state laws, ordinances and regulations applicable with electronic and electrical installations.
  - 3. If there is a conflict between applicable documents, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
  - 4. This document does not replace any code, either partially or wholly. The Contractor must be aware of local codes that may impact this project.

#### 1.3 ABBREVIATIONS AND DEFINITIONS

- A. General: In addition to abbreviations defined in Division 1, utilize the following abbreviations and definitions for discernment with the Drawings and Specifications.

B. Abbreviations:

1. NEC: National Electrical Code
2. OSHA: Occupational Safety and Health Administration
3. ANSI: American National Standards Institute
4. ASIS: American Society for Industrial Security
5. NFPA: National Fire Protection Association
6. ASA: American Standards Association
7. IEEE: Institute of Electrical and Electronics Engineers
8. NEMA: National Electrical Manufacturers Association
9. UL: Underwriter's Laboratories, Inc.
10. ICEA: International Cable Engineers Association
11. ASTM: American Society of Testing Materials
12. ETL: Electrical Testing Laboratories, Inc.
13. TIA: Telecommunications Industry Association
14. ICIA: International Communications Industries Association
15. OEM: Original Equipment Manufacturers
16. EC: Electrical Contractor
17. SCC: Structured Cable Contractor
18. TC: Technology Consultant
19. GC: General Contractor
20. SC: Security Contractor
21. OSP: Outside Service Provider
22. NIC: Not in Contract

C. Definitions:

1. ACCEPTED means as accepted by the Technology Consultant or his representative.
2. APPROVED means as approved by the Technology Consultant or his representative.
3. ARCHITECT means Kimmel Bogrette or their designated representative.
4. AS DIRECTED means as directed by the Technology Consultant or his representative.
5. AS REQUIRED means as required by some other part of the contract documents which may include reference specifications or manufacturer's recommended practice.
6. AS SHOWN means as shown on the drawings, shop drawings or other graphical elements of the contract documents.
7. BIDDER is used to indicate that entity generating the bid response.
8. CONCEALED means embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings.
9. CONDUIT means the inclusion of all fittings, hangers, supports, sleeves, etc.
10. CONTRACTOR is used to indicate the successful Bidder to whom the Owner has awarded the contract.
11. EQUAL means equivalent as approved by the Technology Consultant or his representative.
12. FURNISH means to indicate the responsibility to ship or deliver the item to the job site, freight prepaid, for receipt, staging and installation by others.
13. INSTALL means to join, unite, fasten, link, attach, setup or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular work referred to. It is also used to indicate the responsibility of receiving the item at the job site, providing adequate storage, unpacking or uncrating the item, physically securing the item or otherwise making ready the item for its intended use by following the instructions and approved methods of the manufacturer and those contained herein.
14. OWNER FURNISHED CONTRACTOR INSTALLED (OFCI) shall refer to equipment that will be furnished by the Owner for installation by the Contractor. The Contractor shall be responsible for installing and integrating this equipment as detailed herein.
15. OWNER or CLIENT means Rowan University or their designated representative.

16. PROVIDE means to furnish, install, place, erect, connect, test and turn over to Owner complete and ready for the regular operation, the particular work referred to.
17. PROVIDED BY OTHERS shall refer to material and work which is related to this contract but has been provided by parties other than the Contractor.
18. The term SHALL is mandatory; the term WILL is informative; and the term SHOULD is advisory.
19. TECHNOLOGY CONSULTANT refers to NV5 Technology and Acoustics, 32 Old Slip, Suite 401, New York, NY 10005.
20. WIRING means the inclusion of all raceways, fittings, conductors, connectors, patch panels, labeling, junction and outlet boxes, connections, testing and all other items necessary and/or required in connection with such work.
21. For the purpose of Division 28, in the event of conflict with an abbreviation or definition in Division 01 and in Division 28, the Division 28 abbreviation or definition shall prevail.

#### 1.4 PERMITS, CODES, STANDARDS, AND INSPECTIONS

- A. Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract and shall submit approval certificates to the Technology Consultant.
- B. The installation shall comply fully with all local, county and state laws, ordinances and regulations applicable with electronic and electrical installations.
- C. Unless stated in Division 1, the installation shall be in compliance with the requirements of the latest revisions of:
  1. All approved published instructions set forth by equipment manufacturers.
  2. All local codes and ordinances in effect and having jurisdiction.
  3. Americans with Disabilities Act (ADA)
  4. International Building Code (IBC)
  5. Institute of Electrical and Electronic Engineers (IEEE)
  6. Legislative Act 235 (1965)-Handicapped
  7. Legislative Act 287 (1974)-Excavation
  8. National Electric Code (NEC)
  9. National Board of Fire Underwriter's (NBFU)
  10. National Electrical Manufacturer's Association (NEMA)
  11. National Electric Safety Code (NESC)
  12. Occupational Safety and Health Act (OSHA)
  13. Telecommunications Industry Association (TIA)
- D. Submit certificates issued by approved authorized agencies to indicate conformance of all work with the above requirements, as well as any additional certificates as may be required for the performance of this contract work.
- E. Should any change in drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify the Technology Consultant prior to execution of the work. The work shall be carried out according to the requirements of such code in accordance with the instructions of the Architect and the Technology Consultant at no additional cost to the Owner.

## 1.5 WARRANTIES

- A. Provide complete written warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.
- B. Any material, equipment or appurtenance whose operation or performance does not comply with the requirements of the Contract or any equipment which is damaged prior to acceptance will be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

## 1.6 PROJECT DRAWINGS AND SPECIFICATIONS

- A. The Contractor shall carefully examine the Drawings and Specifications of all trades and report all discrepancies to the Technology Consultant in writing to obtain corrective action. No departures from the Contract Documents will be made without prior written approval from the Technology Consultant.
- B. Questions or disputes regarding the intent or meaning of Contract Documents shall be resolved by the interpretation of the Technology Consultant. The Engineer's interpretation is final and binding.
- C. The Drawings and Specifications are not intended to define all details, finish materials, and special construction, which may be required or necessary. The Contractor shall provide all installations complete and adequate as implied by the project documents.
- D. Drawings are diagrammatic only and do not show exact routes and locations of equipment and associated wiring. The Contractor shall verify the work of all other trades and shall arrange his work to avoid conflicts. In the event of a conflict, the Contractor shall obtain corrective action from the Technology Consultant.
- E. If there is a conflict between contract documents, the document highest in precedence shall control. The precedence shall be: first; permits from agencies as required by law, second; special provisions, third; specifications, fourth; drawings, fifth; reference specifications and sixth; vendor submittals.

## 1.7 COOPERATION AND COORDINATION WITH OTHER TRADES

- A. This Contractor shall be responsible for all cross connections and coordination with vendors and other trades to provide a complete operational system. Coordination shall include the Division 8, Division 26, & the Division 27 contractors.
- B. When installing equipment in finished spaces on furniture, the Contractor shall coordinate the placement and installation method of the equipment prior to commencing installation.

## 1.8 PRODUCT LISTING

- A. When two or more items of the same material or equipment are required, they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, conduit, fittings, sheet metal, solder, fasteners, and similar items, except as otherwise indicated.
- B. Provide products that are compatible within systems and other connected items.

- C. All powered equipment shall be UL listed and follow approval criteria defined by the local authority having jurisdiction.

#### 1.9 RECORD DOCUMENTS

- A. When all work has been completed and before final acceptance, the Contractor shall furnish to the Technology Consultant and Owner a complete set of documents that clearly represent all contract work "as-built." This shall be inclusive of all test results and drawings. The Contractor is responsible for assuring the accuracy of the As-Built documentation.

#### 1.10 MAINTENANCE MANUALS

- A. Prepare maintenance manuals (Record Document) in accordance with the following information for equipment items:
  1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
  2. Manufacturer's data of each piece of equipment.

#### 1.11 GENERAL WARRANTIES

- A. Provide complete warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

#### 1.12 ANY MATERIAL, EQUIPMENT OR APPURTENANCE WHOSE OPERATION OR PERFORMANCE DOES NOT COMPLY WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENTS OR WHICH ARE DAMAGED PRIOR TO ACCEPTANCE WILL BE HELD AS DEFECTIVE AND SHALL BE REMOVED AND PROPERLY REPLACED AT NO ADDITIONAL COST TO THE OWNER.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. Major items of equipment shall have manufacturer's name, address and catalog number on a plate securely attached. All equipment or apparatus of any one system must be the product of one manufacturer or approved equivalent products of a number of manufacturer's that are suitable for use in a unified system.
- B. All materials and equipment for which Underwriter's Laboratories have established standards shall bear a UL label of approval.
- C. Where proprietary names are used, whether or not followed by the words "or as approved," they shall be subject to substitution only as approved by the Architect, Technology Consultant, and Owner.

- D. Where the Contractor proposes substitute equipment, Contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

## PART 3 - EXECUTION

### 3.1 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project identified with names, model numbers, types, grades, compliance labels, and other information needed for distinct identification; adequately packaged and protected to prevent damage during shipment, storage and handling.

### 3.2 INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of systems, materials, and equipment.
- B. Coordinate systems, equipment, and materials installation with other building components.
- C. Verify all dimensions by field measurements.
- D. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for cabling installations.
- E. Sequence, coordinate, and integrate installations of cabling materials and equipment for efficient flow of the Work.
- F. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
- G. Coordinate the cutting and patching of building components to accommodate installation of cabling equipment and materials.
- H. Coordinate the installation of all materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.
- I. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.
- J. Plywood on walls shall be void-free A/C grade and treated on all sides with two coats of fire-resistant paint.
- K. Ensure that the fire rating of all walls and floors is maintained.

### 3.3 CABLE PROTECTION

- A. Cables shall not be exposed to paint, paint remover, water, or any liquids which may degrade the performance of the cable, void the manufacturer's warranty, alter the flame and/or smoke characteristics of the cable, or obscure the flame rating designations printed on the jacket. Cables exposed to paint, paint remover, water, or any liquid shall be replaced by the Contractor.

### 3.4 CONDUIT AND RACEWAY

- A. Actual locations of all equipment, raceways, junction boxes, cable runs, conduit runs, etc., shall be determined at the site.
- B. Provide a pull box or pull point immediately before and after any conduit or raceway section containing three 90° bends, or any single interior run exceeding 50' in length. Pull box openings must face in the direction from which personnel will approach and must have a minimum eight inches in front of and to all sides of the opening. Pull boxes shall not be used in place of a bend. Conduits must always exit the pull box from the opposite side it entered (no change of direction inside the pull box will be accepted).
- C. Carefully investigate the structural, electrical/electronic and finished conditions of work accordingly.

### 3.5 FIRESTOPPING

- A. General
  - 1. Provide through penetration fire stop systems to prevent the spread of fire through openings made in fire-rated walls or floors to accommodate penetrating items such as conduit, cables and cable tray. Fire stop shall restore floor and wall to the original fire rated integrity and shall be waterproof. The fire stop systems and products shall have been tested in accordance with the procedures of U.L. and material shall be U.L. classified as materials for use in through-penetration fire stops.
  - 2. The fire stop system shall comply with the NEC and with NFPA 101-Life Safety Code (latest edition) and shall be made available for inspection by the local inspection authorities prior to cable system acceptance. The Contractor shall be responsible for verifying the fire rating of all walls and floors having cabling penetrations. Coordinate sealant installation with work of other trades and with the general contractor on site.
  - 3. Fire stop systems shall be UL Classified to ASTM E814 (UL 1479) or shall be approved by a qualified Professional Engineer (PE), licensed in the State of New Jersey. A drawing showing the proposed fire stop system shall be provided to the Owner and Technology Consultant prior to installing the fire stop system(s).

### 3.6 GROUNDING AND BONDING

- A. Ground communications systems and equipment in accordance with the TIA-607 Grounding Standard and NEC requirements except where the Drawings or Specifications exceed NEC requirements. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, paging equipment, CATV equipment etc. entering or residing in technology spaces shall be grounded to the respective ground system using a minimum #6 AWG solid copper bonding conductor and compression connectors. All wires used for technology grounding purposes shall be identified with green insulated wires. All cables and bus bars shall be identified and labeled in accordance with the Technology Identification requirements.



3.7 TESTING

- A. Contractor, at his own expense, shall make any tests directed by an inspection authority or by the Technology Consultant and shall provide all equipment, instruments and materials to make such tests.
- B. Upon completion of work, all component parts, both singularly and as a whole, shall be set, calibrated, adjusted and left in satisfactory operation condition to suit load conditions, by means of instruments furnished by the Contractor.

END OF SECTION

## SECTION 280100 - OPERATION AND MAINTENANCE OF ELECTRONIC SAFETY AND SECURITY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This project consists of providing a new access control and surveillance system for the Campbell Library. The access control and surveillance system shall be as shown on the drawings for this location. This project will include cabling as required to support both systems as well as all associated electronics.

#### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 28.
- B. This section is inclusive to all Division 28 sections.
- C. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27.

#### 1.3 DRAWINGS

- A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.
- B. All work shall be subject to the Owner's direction and approval.

#### 1.4 QUALITY ASSURANCE

- A. In addition to procedures stated in Division 1:
  - 1. Cutting and Patching
    - a. Perform required cutting, drilling and chasing to receive new equipment. In general, perform all patching and repairing necessary to restore to original condition, all surfaces that may become damaged during the installation. All work shall be executed by persons normally employed in the type of work to which they are assigned.
    - b. Paint all structural steel and all steel parts used for hangers and for supporting conduits, junction boxes and technology equipment with one (1) coat of "red" oxide primer before erection. After steel is in place, paint again with a minimum of one (1) coat of paint, color as directed by the Engineer or Architect.
    - c. The security contractor is responsible for all cutting and patching associated with the new installation.
  - 2. Clean Up
    - d. Upon completion of the contract, remove all workmen's appurtenances from the premises. Clean the premises of all debris caused by the work and leave the installation clean and in first-class operating condition.
  - 3. Storage of Material and Equipment

- e. Store materials and equipment in a location approved by the Owner.
- f. Be responsible for the condition of all materials and equipment employed in the installation until final acceptance by the Owner.
- g. Be responsible for the replacement of all damaged or defective work, materials or equipment. Do not install sensitive or delicate equipment until major construction work is completed. Ensure that equipment is protected from all construction site activities.
- h. Conform to all applicable safety regulations required by the Owner & OSHA.

#### 1.5 INTERPRETATION AND CONFLICTS

- A. Bring any discrepancies determined or omissions found lacking in the Contract Documents to the Technology Consultant's attention before submitting the bid. After award of Contract, the Owner or Technology Consultant will make the interpretation of any conflict.
- B. The failure to question any controversial item will constitute acceptance by the Bidder who shall execute it to the satisfaction of the Owner after being awarded the Contract.
- C. If mention has been omitted pertaining to details, items or related accessories required for the completion of any system, it is understood such item and accessories are included in the Contract. After the Contract is awarded, claims based on insufficient data or incorrectly assumed conditions, or claims based on misunderstanding the nature of the work, will not be recognized.
- D. The General Conditions, Requirements, and Special Provisions, of any larger body of specifications, of which this Specification may be a part, are hereby made a part of this Specification. In the event that any clauses or provisions of the larger body of specification conflict with the letter or intent of this Specification, the Contractor shall immediately notify the Engineer and the Technology Consultant for clarification and direction.
- E. All work shown shall be new work provided under this Contract except that work labeled "present to remain" and that equipment labeled "to be furnished by others but installed by the Contractor."

#### 1.6 LABELING AND IDENTIFICATION

- A. Clearly LABEL all new equipment, devices and miscellaneous apparatus for easy identification and for safety.

#### 1.7 LOCATION OF EQUIPMENT AND RACEWAY

- A. The drawings are diagrammatic and indicate the general arrangement of equipment to be installed.
- B. Coordinate the structural, electrical/electronic and finished conditions of work accordingly.
- C. Coordinated locations of all equipment, raceways, junction boxes, cable runs, conduit runs, etc., shall be determined at the site. Install all items to accommodate the various conditions in the building and make deviations necessary without additional cost. After the existing ceilings have been removed and prior to commencement of installation, prepare coordination drawings for work under this division, as specified in Division 01, in full cooperation with persons performing work under other Divisions, including but not limited to mechanical, electrical, plumbing, fire protection, information technology cabling, conduit and cable trays, and existing structure. Conflicts encountered due to existing conditions shall be coordinated prior to the installation of all equipment, ductwork, or piping systems. Any modifications to the equipment, duct, or piping

layout shall be reviewed by the Designer and shall not constitute any additional cost to the Owner. Full coordination drawings will be required for the entire facility.

#### 1.8 WIRING METHODS

- A. Install all wire and cable located in finished areas in new or existing raceways as indicated on Drawings.
- B. Install new raceways in the locations shown on the drawings and as specified.

#### 1.9 ORDINANCES AND CODES

- A. Nothing contained in the Specifications or shown on the drawings shall be construed as to conflict with any local, municipal or state laws and regulations, governing the installation or other contract work, and all such ordinances and regulations, including the latest: National Electric Code, TIA standards and the National Electric Safety Code, are hereby incorporated and made a part of these Specifications, and shall be satisfied by the Contractor at no additional expense to the Owner.
- B. Secure all permits and inspection certificates for submission to the Owner.

#### 1.10 SYSTEM CONTINUITY

- A. Reconnect all existing items that remain in use. Provide all materials and labor required to retain continuity of existing circuits or systems that are disrupted by these alterations even though not indicated on the drawings.

#### 1.11 SUBMITTALS

- A. Shop drawings shall be checked, corrected and approved by the Contractor before being submitted to the Owner/Technology Consultant for review. Before submitting shop drawings, the Contractor shall carefully examine them and shall certify by his stamp/signature that, to the best of his knowledge, they comply with the Contract Documents. The Contractor must receive written approval from the Owner or an authorized representative of the Owner, in writing, prior to fabricating or installing any materials. Approval will be given based upon shop drawings. The shop drawings shall indicate complete details of work to be performed. Drawings shall include a title block naming the Project, Engineer, Technology Consultant, Contractor, drawing title, drawing number, revision number if applicable and date. Submit all Shop Drawings complete as a single submission. Isolated items will not be accepted, except with prior approval.
- B. Where the shop drawings deviate from the requirements of the Contract documents, the Contractor shall (1) correct the shop drawings as required, or (2) where the deviations do not necessarily require correction, notify the Owner/Technology Consultant of the deviations.
- C. Submit to the Technology Consultant four (4) sets of shop drawings or otherwise noted documents/equipment for the following equipment and obtain written approval before ordering materials. See the drawings and scope information for applicability of product to phase and project:
  - 1. Access Control Panels
  - 2. Power Supplies

3. Cabling
  4. Protection Devices
  5. Patch Cables
  6. Cable management Devices
  7. Cameras
  8. IP Camera Cabling
  9. Camera Housings
  10. Monitors
  11. Servers and Workstations
  12. Software
  13. Racks and cabinets
  14. Grounding equipment
  15. Hangers and Supports
  16. Strain relief products
  17. Intercom Equipment
  18. Indoor and outdoor Intercom Stations
  19. All other equipment identified or inferred and as may be required by the Engineer, Architect, Technology Consultant or Owner.
- D. Submit complete submittal list for Owner/Technology Consultant review prior to purchasing any equipment.
- E. Where multiple products are shown on one cut sheet, circle product to be used.
- F. In some cases, manufacturer warranty may call for the review of system documentation to assure that the system design meets manufacturer warranty requirements. In such instance, with prior approval of the Owner, the Contractor shall provide a complete set of Project Documents and product data to the system manufacturer for review. The system manufacturer shall review the complete system package and provide documentation attesting to the system compliance with manufacturer warranty requirements. This documentation shall be included with the Contractor Shop Drawings submittal. The Technology Consultant will not review the Contractor Shop Drawings submittal which does not include the manufacturer warranty compliance review documentation.
- G. Each shop drawing shall contain reference to the applicable drawing and specification section and verification of compatibility with the systems involved.
- H. All nameplate data shall be submitted with equipment submittals – refer to other sections for complete identification requirements.
- I. Shop drawings shall show conformance with specified performance characteristics, or the Contractor shall assume responsibility for all deviations including all additional costs as a result of the deviations.
- 1.12 STANDARDS OF MATERIAL AND WORKMANSHIP
- A. All work shall be executed by persons skilled in the work to which they are assigned. This shall include all copper and fiber connections including testing, and all plastering and painting.
- B. All materials and equipment in the work shall be new and of first quality, produced by manufacturers of recognized reputation for each line of material and equipment. The fact that materials or equipment offered have been recently developed or are untried may be sufficient justification for their rejection.

#### 1.13 PROTECTION OF WORK AND EQUIPMENT

- A. The Contractor shall use the required safety precautions, methods and skills to prevent possible unsafe conditions or conditions unduly susceptible to fire.
- B. When the Contractor is working in areas in which the building occupants have access, Contractor shall provide suitable barriers around his operation.
- C. The Contractor is responsible for containing the undue spread of vapors or odors from his work area.

#### 1.14 TESTS AND INSTRUCTIONS

- A. Upon completion of the work, and upon the request of the Technology Consultant, the Contractor shall be prepared to test all systems in the presence of the Owner or Technology Consultant. Such testing shall occur at a time that is mutually acceptable to all parties. The Contractor's representatives assisting in the performance of these tests shall be thoroughly familiar with the details of the system and shall include the field supervisor responsible for installing the system.
- B. Correct all failures or improper conditions.
- C. Demonstrate to the Owner the proper care and maintenance of all new items.

#### 1.15 GUARANTEE

- A. Unless stated otherwise in Division 1:
  - 1. The Contractor and his surety shall guarantee in writing for a minimum period of one (1) year from the date of final acceptance that all materials, equipment and labor furnished by Contractor are free from defects.
  - 1. The Contractor shall further guarantee that if any piece of material or equipment is found to be defective within the guarantee period because of faulty manufacture or faulty installation, in the opinion of the Owner, Contractor will replace and install and test such material or equipment without any further expense to the Owner.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

## SECTION 280526 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 28.
- B. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27.

#### 1.2 SUMMARY

- A. This Section includes solid grounding of technology systems and equipment. It includes basic requirements for grounding for protection of life, equipment circuits and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.
- B. Comply with the TIA-607, "Grounding and Bonding Requirements" and the NEC.

#### 1.3 SUBMITTALS

- A. Submit the following:
  - 1. Product data for connectors and connections materials, and grounding fittings.
    - a. Where multiple products are shown on one cut sheet, circle product to be used.
  - 2. Field-testing organization certificates, signed by the Contractor, certifying that the organization performing field tests complies with the requirements specified in Quality Assurance below.
  - 3. Report of field tests and observations certified by the testing organization.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings of types and rating required, and ancillary grounding materials, including stranded cable, copper braid and bus, ground rods and plate electrodes, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer: Qualified with at least 3 years of successful installation experience on projects with technology ground work similar to that required for this project.
- C. Listing and labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electric Code, Article 100.
- D. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

- E. Field-testing Organization Qualifications: To qualify for acceptance, the independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated.
- F. Component Standard: Components and installation shall comply with NFPA 70, "National Electric Code" (NEC).
- G. UL Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to electrical and electronic grounding.
- H. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical and electronic grounding.

## PART 2 - PRODUCTS

### 2.1 GROUNDING AND BONDING PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. B-Line Systems, Inc.
  - 2. Burndy Corp.
  - 3. Crouse-Hinds Co.
  - 4. Electrical Components Div.; Gould Inc.
  - 5. General Electric Supply Co.
  - 6. Ideal Industries, Inc.
  - 7. Thomas and Betts Corp.

### 2.2 PRODUCTS

- A. Supply types indicated and of sizes and rating to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

### 2.3 CONDUCTOR MATERIALS

- A. Copper with min 98% conductivity.

### 2.4 WIRE AND CABLE CONDUCTORS

- A. Coordinate with Division 26 and Division 27 Sections.
- B. Equipment Grounding Conductor: Green insulated.
- C. Grounding Electrode Conductor: Stranded cable.
- D. Bare Copper Conductors:
  - 1. Conform to the following:
    - a. Solid Conductors: ASTM B-3.



- b. Assembly of Stranded Conductors: ASTM B-8.
- c. Tinned conductors: ASTM B-33.

## 2.5 MISCELLANEOUS CONDUCTORS

- A. Ground Bus: Bare annealed copper bars of rectangular cross section. All bus bars shall be two-hole lug type.
- B. Bonding Strap Conductor/Connectors: Soft copper, 0.05-inch-thick and 2 inches wide, except as indicated.
- C. Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gauge bare copper wire, 3/4" wide, 9-1/2" long; 48.250cm. Protect braid with copper bolt-hole ends with holes sized for 3/8" diameter bolts.

## 2.6 CONNECTOR PRODUCTS

- A. Listed and labeled as grounding connectors for materials used and approved by a nationally recognized testing laboratory.
- B. Pressure Connectors: High-conductivity-plated units. All lugs shall be two-hole type.
- C. Bolted Clamps: Heavy-duty units listed for the application.

## 2.7 GROUNDING ELECTRONICS

- A. For technology systems, provide a #6 AWG minimum insulated stranded copper conductor from the grounding electrode system to each telecommunication room, terminal cabinet and central location.
- B. Bonding Plates, Connectors, Terminals and Clamps: Provide electrical bonding plates, connectors, terminals, lugs and clamps as recommended by manufacturers for indicated applications.
- C. Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials and bonding straps, as recommended accessories by manufacturers.

# PART 3 - EXECUTION

## 3.1 GENERAL

- A. Each facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical building ground and shall be designed in accordance with the recommendations contained in the TIA -607 Telecommunications Bonding and Grounding Standard. All security equipment and systems residing in telecommunications rooms shall be properly connected to the TBB.

- B. The main communications entrance facility/equipment room shall be equipped with a telecommunications main grounding bar (TMGB). Each telecommunications room shall be provided with a telecommunications ground bar (TGB) connected to the TMGB by a #6 AWG minimum insulated stranded copper conductor. The TMGB shall be connected to the building electrical entrance grounding facility (master ground bus) with a #2 AWG minimum insulated stranded copper conductor. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.
- C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, and security equipment entering or residing in telecommunication spaces shall be grounded to the respective TGB or TMGB using a minimum #6 AWG insulated stranded copper conductor and compression connectors.
- D. All cables and bus bars shall be identified and labeled in accordance with the Identification requirements Section 280553.
- E. Except as otherwise indicated, provide grounding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, terminals (solderless lugs), bonding jumper braid, surge arresters, and additional accessories needed for complete installation. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE, and established industry standards for applications indicated.
- F. All bonding conductors shall not be placed in a ferrous metallic conduit. If it is necessary to place any bonding conductors in ferrous metallic conduit that exceeds 1 meter in length, the grounding conductors shall be bonded to each end of the conduit with a conductor sized as a # 6 AWG minimum.
- G. All connections to building steel shall be exothermically (CAD) welded and connected to the telecommunications grounding bus bar with a minimum #2 AWG cable.
- H. All cable tray and equipment racks shall be bonded together with grounding straps of a minimum of a #6 AWG cable. Bonding cables shall be equipped with a compression type ground lug on both ends. The ground lugs shall be attached to a point on the rack that is free of paint and equipped with a star washer. After connecting the ground lugs, seal the connection.
- I. All ground cable connections to the telecommunications ground bar shall be with compression type lugs. No setscrew type lugs shall be used.
- J. All ground conductors shall be routed in a neat and workmanlike manner and shall be free of splices, sharp bends, and kinks.
- K. All new and existing protected entrance terminals in the telecommunications room shall be grounded and connected to the telecommunications grounding bar with a # 6 AWG conductor.
- L. Bond the Data/Communications cable tray located in the at the building service entrance points with a minimum of # 2 AWG cable. Note that each tray is grounded at one building service entrance panel only. Connect the bonding conductor to the tray bonding conductor with a compression type fitting. No setscrew type lugs shall be used.

### 3.2 INSPECTION

- A. Installer must examine areas and conditions under which technology grounding connections are to be made and notify the Technology Consultant in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner.

### 3.3 APPLICATION

- A. Provide technology grounding systems where shown, in accordance with applicable portions of NEC and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.

### 3.4 INSTALLATION

- A. Ground communications systems and equipment in accordance with the TIA -607 Grounding Standard and NEC requirements except where the Drawings or Specifications exceed these requirements.
- B. Coordinate with other work as necessary to interface installation of grounding system with other work.
  - 1. Where the security equipment is located in the buildings' Telecom rooms, the security contractor shall, in lieu of building out a separate grounding system, tie the security systems grounds to the telecom grounding system.
- C. Route grounding conductors along the shortest and straightest paths without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
- D. Install bonding connections in accessible locations with approved components.
- E. Each TGB shall be directly bonded to the main electrical ground rod.
- F. The TGB and TMGB must be visibly labeled and physically secured.
- G. Where the ground wire is exposed support at a minimum of every 24" both vertically and horizontally.

### 3.5 CONNECTIONS

- A. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
- B. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer to in order of galvanic series.
- C. Make connections with clean bare metal at points of contact.
- D. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

- E. Tighten grounding and bonding connectors and terminals, (including screws and bolts) in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

### 3.6 FIELD QUALITY CONTROL

- A. Upon completion of installation of technology grounding systems, test ground resistance with ground resistance tester. Where tests show resistance to ground is over 10 ohms, take appropriate action to reduce resistance to  $2\Omega$  or less.

### 3.7 LABELING

- A. All ground cables shall be labeled in accordance with ANSI/TIA-606.

END OF SECTION

## SECTION 280529 - HANGERS AND SUPPORTS FOR ELECTRONIC SAFETY AND SECURITY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Provisions and Supplementary Conditions, Specification Sections, apply to this and the other sections of Division 28.
- B. This section is a Division 28 BASIC section and is to be considered as a part of each Division 28 section.
- C. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27.

#### 1.2 SUMMARY

- A. This Section includes secure support from the building structure for security items by means of hangers, supports, anchors, sleeves, inserts, seals and associated fastenings.
- B. All support shall utilize threaded fasteners for all technology/attachments
  - 1. Exception:
    - a. Spring steel fasteners may be used in lieu of threaded fasteners only for  $\frac{3}{4}$ " raceways above suspended ceilings.
- C. Types of supports, anchors, sleeves and seals specified in this section include the following:
  - 1. Clevis hangers
  - 2. Riser clamps
  - 3. C-clamps
  - 4. I-beam clamps
  - 5. Conduit straps
  - 6. Round steel rods
  - 7. Lead expansion anchors
  - 8. Toggle bolts
  - 9. Wall and floor seals
- D. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment, are specified as part of that equipment assembly or as specified in Division 28.

#### 1.3 SUBMITTALS

- A. Submit the following in accordance with Conditions of Contract and Supplementary Conditions Specifications Sections.
  - 1. Product Data: Submit manufacturer's data on supporting devices including catalog cuts, specifications, and installation instructions, for each type of support, anchor, sleeve and seal.
    - a. Where multiple products are shown on one cut sheet, circle product to be used.

2. Shop Drawings: Submit dimensioned drawings of fabricated products, indicating details of fabrication and materials.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacturing of supporting devices, of types, sizes, and ratings requirements, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Contractor Qualifications: Firm shall have at least 3 years of successful installation experience with projects utilizing electronic/electrical supporting device work similar to that required for this project.
- C. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of supporting devices.
- D. UL Compliance: Provide components that are UL listed and labeled.
- E. FS Compliance: Comply with Federal Specification FF-S-760 pertaining to retaining straps for conduit, pipe and cable.
- F. Components shall be listed and labeled by ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Major items of equipment shall have manufacturer's name, address and catalog number on a plate securely attached. All equipment or apparatus of any one system must be the product of one manufacturer or approved equivalent products of a number of manufacturer's that are suitable for use in a unified system.
- B. All materials and equipment for which Underwriters Laboratories have established standards shall bear a UL label of approval.
- C. Where proprietary names are used, whether or not followed by the words "or as approved," they shall be subject to substitution only as approved by the Architect, Technology Consultant, and Owner.
- D. Where the Contractor proposes substitute equipment, Contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance rating, size and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Provide supporting devices that comply with manufacturer's standard materials. Install in accordance with published product information, and as required for a complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Contractor's option.
- B. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NEC for installations of supporting devices.
- C. All camera mounting brackets (wall, pendant, & parapet) shall be of proper wind rating such that they are resistant to wind sway and vibration. Camera devices shall be installed to maximize stability.
- D. Support all technology cables a minimum of every 4' with J-hooks unless other supports are available. For CCTV Camera cabling and all other Category 6 (or 6A) cabling, utilize only those systems specifically approved for that type of cabling.
- E. Coordinate with the building structural system and electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- F. Do not fasten supports to pipes, ducts, mechanical equipment and conduit.
- G. Obtain approval from the Engineer and Architect before drilling or cutting structural members.
- H. Install surface-mounted cabinets and panels with minimum of four anchors.

### 3.2 MISCELLANEOUS SUPPORTS

- A. Support miscellaneous technology components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panels, control enclosures, pull boxes, junction boxes and other devices.

### 3.3 FASTENING

- A. Unless otherwise indicated, fasten technology items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, cabinets, panels, boxes and control components in accordance with the following:
  - 1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

- B. Holes cut into reinforced concrete beams or in concrete shall not cut reinforcing bars. If the Contractor cuts into any reinforcing bars, stop work and notify the Technology Consultant immediately. Fill all holes that are not used.
- C. Ensure that the load applied to any fastener does not exceed 25% of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.

### 3.4 TESTS

- A. Test pull-out resistance of one of each type, size and anchorage material for the following fastener types:
  - 1. Expansion anchors.
  - 2. Toggle bolts.
  - 3. Powder-driven threaded studs.

END OF SECTION



## SECTION 280553 - IDENTIFICATION FOR ELECTRONIC SAFETY AND SECURITY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 28.
- B. Drawings and general provisions including Division 1, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes requirements for identification of components including but not limited to the following:
  - 1. Identification labeling for cables and conductors
  - 2. Operational or instructional signs
  - 3. Equipment labels and signs
- B. Refer to project drawings and other Division 28 sections for additional specific identification associated with specific items.
- C. The Contractor shall submit, for review by the Technology Consultant and Owner, a labeling system for the cable installation. The Owner will coordinate the exact verbiage of the labeling scheme with the successful Contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cabinets, ground bars, cables, panels and outlets. The labeling system shall designate the cables' origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.
- D. All label printing shall be machine generated using indelible ink ribbons or cartridges. Self-laminating labels shall be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.

#### 1.3 SUBMITTALS

- A. Submit the following:
  - 1. Manufacturer's data for each type of product specified.
  - 1. Schedule of identification and nomenclature to be used for identification signs and labels.
  - 2. Samples of each color, lettering style and other graphic representation required for identification materials.

#### 1.4 QUALITY ASSURANCE

- A. UL Compliance: Comply with applicable requirements of UL Standard 969, "Marking and Labeling Systems", with regard to type and size of lettering for raceways and cable labels.
- B. NEMA Compliance: Comply with applicable requirements of NEMA Standards WC-1 and WC-2 pertaining to identification of power and control conductors.
- C. Major items of equipment shall have manufacturer's name, address and catalog number on the plate securely attached in a convenient place.

#### 1.5 SUGGESTED NUMBERING AND LABELING SCHEME

- A. Surveillance Camera: (AAA-B-CC-DD).
  - 1. AAA is the room/corridor the camera is located.
  - 1. B is the camera number in this room/corridor.
  - 2. CCC is the telecom room which serves this camera.
  - 3. DD is the patch panel port of the cable termination.
  - 4. Labeling techniques: The label shall be black letters on white background. Labels must be produced by label-making equipment. The blank white label tags that are included in the faceplate hardware are to be installed with clear plastic shields in all positions on the faceplate.
- B. Electronic safety and security electrical receptacles:
  - 1. Each electrical receptacle providing power to any component of the electronic safety and security system shall be labeled with the following information: room number where electrical panel is located, panel number, and circuit number. Each receptacle is to be labeled on top or front of the faceplate or outlet box. Preprinted adhesive labels or tags shall be used.

### PART 2 - PRODUCTS

#### 2.1 TECHNOLOGY IDENTIFICATION PRODUCTS

- A. Cable/Conductor Identification bands:
  - 1. Provide Manufacturer's standard wrap-around cable/conductor markers, of size required for proper application, and numbered to show circuit identification.
- B. Equipment Labels
  - 1. General: Provide engraved stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening.
  - 1. Thickness: 1/16", for units up to 20 sq. in. or 8" length; 1/8" for larger units.
- C. Lettering and Graphics

- D. General: Coordinate names, abbreviations and other designations used in technology identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the technology systems and equipment.
- E. Fasteners for Plastic-Laminated Signs shall be self-tapping stainless-steel screws or number 10/32 stainless steel machine screws with nuts and lock washers.
- F. Exception: Where specifically approved contact type permanent adhesive may be used where screws cannot or should not penetrate substrate.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application.
- B. Lettering and Graphics: Coordinate names, abbreviations, colors and other designations used in technology identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as reviewed in submittals and as required by standards.
- C. Install identification devices as indicated, in accordance with manufacturers written instructions.
- D. Sequence of work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

### 3.2 CABLE/CONDUCTOR IDENTIFICATION

- A. Apply cable/conductor identification on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present. Match identification with marking system used on shop drawings, contract documents, and similar previously established identification for project's technology work.

### 3.3 OPERATIONAL SIGNS

- A. Provide instructional signs with approved legend where instructions or explanations are needed for system or equipment operation.

### 3.4 OUTLET IDENTIFICATION

- A. Label each voice and data outlet with the proper designation and provide appropriate icon.

### 3.5 INSTALLATION

- A. Provide equipment identification labels of engraved plastic-laminate on all equipment racks and on major units of technology equipment in buildings. Except as otherwise indicated, provide single line of text, with ½" high lettering on 1½" high label (2" high where two lines are required), white

lettering in black filed. Text shall match terminology and numbering of the Contract Documents and shop drawings.

- B. Provide labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION

## SECTION 281300 – ACCESS CONTROL

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes a security management information system (SMS) for the new Campbell Library and shall provide all of the functionality described herein and shown on the project drawings.
1. SMS components:
    - a. Access Control Server
    - b. Intelligent Controller
    - c. Input Output Devices
    - d. Card readers
    - e. Biometric readers
    - f. Panic Buttons
    - g. All cabling as required for each system
  2. Security Management System Functionality:
    - h. Regulating access through doors, and gates.
    - i. Issuing and enrolling multiple types of access credentials
    - j. Identifying credential via compatible readers.
    - k. Anti-passback where required.
    - l. Surge and tamper protection.
    - m. RS-232, RS-485, and/or IP-based interface.
    - n. Interfaced with building UPS/generator.
    - o. Production of physical credentials
    - p. Managing credential holder database
    - q. Monitoring alarms from field-installed devices
    - r. Monitoring of field-installed devices.
    - s. Tracking and reporting system events
    - t. Input and output linking
    - u. Video interface and control
- B. Related Sections:
1. Section 280000: Common Work Results for Electronic Safety & Security
  2. Section 280100: Operation & Maintenance of Electronic Safety & Security
  3. Section 280529: Hangers and Supports for Electronic Safety & Security
  4. Section 280553: Identification for Electronic Safety & Security
  5. Section 282300: Surveillance System
- C. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27.

#### 1.2 PROJECT CONDITIONS

- A. Project is a renovation of the existing Campbell Library at Rowan University.

### 1.3 ACS PERFORMANCE REQUIREMENTS

- A. Distributed Processing: System must be a fully distributed processing system so that information, including time, date, valid codes, access levels, and similar data, is downloaded to Controllers so that each Controller makes access-control decisions for that Location. Do not use intermediate Controllers for access control. If communications to Master Control are lost, all Controllers must automatically buffer event transactions until communications are restored, at which time buffered events must be uploaded to the Master Control.
- B. System Capacity:
1. 1000 reader-controlled doors.
  2. 10,000 total access credentials.
  3. 10,000 supervised alarm inputs.
  4. 10,000 programmable outputs.
  5. 10,000 custom action messages.
- C. System Network Requirements:
1. Provide for automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
  2. Communication must not require operator initiation or response and must return to normal after partial or total network interruption such as power loss or transient upset.
  3. System must automatically annunciate communication failures to the operator and identify the communication link that has experienced a partial or total failure.
- D. Environmental Capabilities: System must be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
1. Control Station: Rated for continuous operation in ambient conditions of 60° to 85° F and a relative humidity of 20 to 80 percent, noncondensing.
  2. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments must be rated for continuous operation in ambient conditions of 36° to 122° F dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 1 enclosure.
  3. Interior, Uncontrolled Environment: System components installed in non-air-conditioned and non-temperature-controlled interior environments must be rated for continuous operation in ambient conditions of 0° to 122 ° F dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 12 enclosures.
  4. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.
- E. System must provide operator interface, interaction, display, control, and dynamic and real-time monitoring. System must control system networks to interconnect all system components, including workstations and field-installed Controllers.
- F. Field equipment must include Controllers, sensors, and I/O devices. Controllers must serve as an interface between the system headend and sensors and controls. Data exchange between the System and the Controllers must include down-line transmission of commands, software, and databases to Controllers. The up-line data exchange from the Controller to the System must include status data such as intrusion alarms, status reports, and entry-control records. Controllers are classified as alarm-annunciation or entry-control type.
- G. System Response to Alarms: Field device network must provide a system end-to-end response time of 1 second(s) or less for every device connected to the system. Alarms must be annunciated

at the Monitoring workstation within 1 second of the alarm occurring at a Controller or device controlled by a local Controller. Alarm and status changes must be displayed within 100ms after receipt of data by the System. All graphics must be displayed, including graphics-generated map displays, on the console monitor within 5 seconds of alarm receipt at the security console. This response time must be maintained during system heavy load.

- H. False Alarm Reduction: The design of System and Controllers must contain features to reduce false alarms. Equipment and software must comply with SIA CP-01.
- I. Data Line Supervision: System must initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.
- J. Door Hardware Interface: Coordinate with Division 8 Sections that specify door hardware required to be monitored or controlled by the security access system. The Controllers in this Section must have electrical characteristics that match the signal and power requirements of door hardware, including door monitors and latch detection where required. Integrate door hardware specified in Division 8 Sections to function with the controls and PC-based software and hardware in this Section.
- K. Licensing: the system shall be bid to the Owner as a "Turn-Key" system. It shall contain all and any necessary user licenses (at no additional cost) as required for a fully functioning system as specified.
- L. Cyber Security: The system shall include provisions within its software designed to protect the various user databases and control functions from attacks from the outside via cyber-space. System shall be configured, at the time when it is turned over to the Owner, to protect against the most recent known threats.

#### 1.4 SUBMITTALS

- A. Floor plans showing the entire area with room numbers, locations for each device, riser diagram, point to point diagram, symbol of all devices being used. Indicate system components, location and provide full schematic of wiring system showing building, operation details.
- B. Product Data: For each type of product indicated. Include operating characteristics, furnished specialties, and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data must comply with SIA BIO-01. Include submittals for, but not limited to the following:
  - 1. ACS server
  - 2. ACS Controller
  - 3. ACS I/O Panels
  - 4. Readers and input devices
- C. Shop Drawings:
  - 1. Diagrams for panel layouts in equipment rooms with cable management system.
  - 2. System labeling schedules, including electronic copy of labeling schedules that are part of the cable.
  - 3. Wiring Diagrams. Show typical wiring schematics including:
    - a. Main control panel
    - b. Typical I/O Panel
  - 2. Battery Calculations

- a. Provide battery calculations for power supplies/chargers indicating a minimum 4-hour of battery backup runtime.
- D. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. Include the following:
1. ACS software documentation.
  2. The Contractor will provide all software configuration files for any/all software utilized on the project.
  3. System installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software must include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
  4. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
  5. System installation and setup guides, with data forms to plan and record options and setup decisions.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70, "National Electrical Code."
- D. Equipment and accessories furnished under the terms of this specification shall be the standard products of manufacturers regularly engaging in the manufacture of this type of product(s) for a period of at least three years.
- E. All products within this bid, deemed by the manufacturer as "End of Life" at the time of installation shall be replaced with the next generation replacement in kind, at no additional cost to the Owner.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Workstations, and Controllers:
  1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50° and 85° F, and not more than 80 percent relative humidity, noncondensing.
  2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
  3. Mark packing list with designations that have been assigned to materials and equipment for recording in the system labeling schedules that are generated by cable and asset management system specified in Part 2.
  4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.



## 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Card Readers: Minimum of two of each type of identification device
  - 2. Power Supplies: Minimum of two of each type
  - 3. Credential card blanks, ready for printing. 250 blanks plus an extra 25 % for future use.
- B. Fuses of all kinds, power and electronic, equal to 10% of amount installed for each size used, but no fewer than three units.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

#### A. MANUFACTURERS

- 1. The Basis of Design shall be the Lenel OnGuard platform. Contractors shall provide hardware from Mercury Security as an approved partner of Lenel.

### 2.2 SECURITY MANAGEMENT SYSTEM (SMS) HARDWARE

- A. Intelligent Controller (IC): The IC shall be a Linux based access control platform. It shall directly support the above-listed SMS platform(s) The IC shall include the following capabilities:

#### 1.1 Multi-card & Multi-reader Technology support

- a. 8 active card formats per IC
- b. OSDP Reader Integration (V.2)
- 2. AES 128- or 256-bit data encryption
- 3. MSP1 Encryption
- 4. HSPD-12/FIPS201 capable
- 5. UL 294 recognized
- 6. On-board memory to support:
  - a. 2,000,000 user records
  - b. 50,000 transactions (event buffer)
- 7. 255 Access levels
- 8. High Assurance Credential Authentication
- 9. BACnet compliant for connection & control of building automation systems
- 10. Basis of Design: Mercury Security EP 4502

#### B. I/O Devices

- 1. Provide I/O devices as required to provide for all door requirements at each equipment room location.
  - a. Provide 10% spare capacity at each central equipment location to allow growth without adding more panels.
- 2. Provide in combination from the following devices to meet the door control and input device requirements for each equipment location.
  - a. Mercury Security MR50
  - b. Mercury Security MR51e
  - c. Mercury Security MR52

- d. Mercury Security MR16IN
- e. Mercury Security MR16OUT

C. Wall-Mount Cabinets

- 1. Contractor shall utilize the larger size cabinet for their controllers to allow better working space within.
- 2. Provide cabinets as provided by or recommended by the SMS System manufacturer.
- 3. All cabinets/boxes shall include tamper switches.

D. Card Reader:

- 1. Provide wall-mounted and/or mullion-mounted card readers as shown on the drawings. Card readers shall be sized and selected to fit the available space and shall be approved in advance before purchase.
- 2. Card Readers shall be compatible with existing card base but be capable of the latest in secure reader transmission protocol MIFARE DESFire (EV1 & EV2).

E. Panic Button

- 1. Provide panic buttons at each location shown on the drawings. Panic buttons shall be connected directly to the Lenel control panels.
  - a. Basis of Design: Inovonics EN1235SF

F. Power Supply:

- 1. Provide Altronix 600 series or approved equal.
- 2. Provide Altronix PD8CB's for all power supplies.
  - a. All locks shall be powered @ 24vdc
  - b. All other devices shall be powered @ 12vdc.
- 3. All power supplies shall be supervised through the OnGuard system.
- 4. All power supplies shall include battery backup providing a minimum of 4-hour battery runtime.

## 2.3 APPLICATION SOFTWARE

- A. Contractor is responsible to provide, install, configure and test any or all of the Access Control System's capabilities, based on the project planning process described in Paragraph 3.2.
- B. One of the SMS's primary purposes shall be to provide access control. The SMS shall be able to make access granted or denied decisions, define access levels, and set time zones and holidays. An input or output linkage feature shall allow linking of monitor zone points to output control points within Intelligent System Controllers (ISCs). The SMS shall support features such as area control (two-man control, hard, soft, and timed anti-passback), database segmentation, and Time zone or holiday overrides.
- C. The Contractor will provide and install a complete Credential Production and Management Subsystem: The SMS shall include a seamlessly integrated credential management module. The credential management functionality must be configured to permit the enrollment of cardholders into the database, capturing of images from video, biometric data, and signatures, as well as the import or export of employee data. This functionality shall also allow the System Operator to assign and/or modify the access rights of a cardholder.

- D. Alarm Monitoring: The main Alarm Monitoring window shall provide information about the time and location of the alarm, along with its priority. The main Alarm Monitoring window must be able to sort pending and/or insert new alarms based on any of the following attributes: priority, date or time, alarm description, Intelligent System Controller, Card Reader, Input Control Module, asset name, or cardholder. Date or time sorts must be System Operator selectable to be either ascending or descending and must have the option of displaying the seconds of the minute in which the alarm arrived into the SMS.
- E. Digital Video Management: The SMS shall be seamlessly integrated to a digital video management module. It shall support real-time linkage of digital video clips to their associated alarms as well as those from linked devices in the SMS database, Access Control hardware for example. This linkage shall happen automatically as defined by the configuration.
1. Where applicable, System Administrators shall define parameters for video segment creation by specifying pre-alarm and post-alarm durations. The system shall automatically associate alarms from linked hardware with the linked camera's pre and post-alarm durations.
  2. The SMS shall support Digital and Network Video Recorders from multiple manufacturers. The SMS shall also support IP-based digital cameras and digital video encoders or servers from multiple manufacturers for advanced video surveillance. The SMS shall support MJPEG, MPEG4 simple profile encoding standards and frame rates to include both PAL and NTSC respectively at maximum of 25/30 frames per second. In addition, the SMS shall support a network-based digital video recorder.
- F. Third-Party Interfaces: The SMS shall provide seamless integration with a variety of 3<sup>rd</sup> party systems. The SMS shall allow alarms and events from the third-party systems to report into the same main Alarm Monitoring window as access control alarms. Third-party interface hardware shall be configured in the SMS access control module. In some cases, System Operators shall be able to control third-party hardware devices from the Alarm Monitoring Workstation. Third-party hardware alarms and events shall be stored in the SMS database for audit trail and reporting purposes.
- G. The SMS shall support a real time, bi-directional data interface to external databases such as Human Resources, Time and Attendance, Food Service Systems. The interface shall allow data to be imported into or exported out of the SMS in real-time or in a batch mode basis. Data used for import shall be retrieved directly from an external database or through an import file. Data provided for export shall be applied directly to an external database or through an export file. Any data shall be imported or exported including image data. The file used for import or created by export shall have the ability to be structured in a wide variety of ways but shall always be in ASCII text format.
- H. The SMS shall also support a one-step download and distribution process of cardholder and security information from the external database to the SMS database, all the way down to the Intelligent System Controller (ISC) database. This shall be a guaranteed process, even if the communication path between the SMS database and the ISC is broken. If the communication path is broken, the data shall be stored in a temporary queue and shall be automatically downloaded once the communication path is restored.
- I. API Development Toolkit: While customization is to be minimized, the SMS shall allow, through API toolkits, System Administrators to expose specific SMS data and events that are relevant to IT information or other third-party systems. Conversely, the SMS shall allow, through these same API toolkits, System Administrators to accept and process information exposed from the IT information or other third-party systems. This shall permit System Administrators to develop scripts and applications that allow events in either the IT domain to cause appropriate actions in the Security domain, and vice versa.

- J. Scheduling Utility: An integral Scheduling Utility shall be provided. The Scheduling Utility shall allow System Administrators to schedule actions to occur on a one-time or a recurring basis. Recurring schedules shall be configured to begin immediately, last indefinitely, or have optional start and end dates.
1. The Scheduling Utility shall maintain a history log in the database for actions that it executes.
- K. The SMS shall import and support .pdf, .dxf, & .rvt file extensions (minimum) for use as graphical display format of building layouts. The system shall support map hierarchies or maps within maps. There shall be no limit to the number of maps that shall be nested hierarchically with each other. Multiple maps may be displayed simultaneously.
- L. Contractor shall install and configure Integrated Intrusion Detection Interface IF required. Provide seamless integration with intrusion detection panels. This shall allow for the ability to monitor intrusion detection alarms in real time inside the SMS alarm monitoring module and allow for command and control of supported intrusion detection. Once alarms are brought into SMS, they shall have the ability to be linked to digital video and/or global I/O, and they shall be stored in the SMS database.
- M. Security Management System (SMS) Hardware is required to receive alarms and administer all access granted or denied decisions. All field hardware must be designed to meet UL 294 requirements. The SMS must be able to retrieve device serial numbers from all field hardware, excluding card readers, biometric readers, and keypads.
- N. SMS Third-party Devices: The SMS shall interface at the software level via pre-developed interface package with select devices from any 3<sup>rd</sup> party manufacturers.

## 2.4 ACS WORKSTATION/BADGING STATION REQUIREMENTS

- A. Workstation/Badging Station shall be:
1. Dell XPS Tower Series
  2. Intel Core i7-9700
  3. Microsoft Windows 10 (64 bit)
  4. 16GB DRAM
  5. 1 TB Hard Drive (SSD)
  6. DVD-read/writable
  7. High output graphics card
  8. APC Smart-UPS 1500 LCD UPS for each PC and the associated monitor.
  9. Equals by SurgeX, Tripp Lite, CyberPower, Minuteman
  10. Shall include manufacturer's badge printer and all relevant associated materials.
- B. Monitors shall be:
1. 24" Monitor shall be Dell Model U2418HX, complete with the following features/options:
    - a. 1920 x 1200 @60Hz native resolution
    - b. 16.7 million colors
    - c. Front Panel Controls
    - d. Contrast ratio 8,000,000:1 (dynamic mode)
    - e. 2 x HDMI inputs, VGA
    - f. 120-volt operation

## 2.5 SURGE AND TAMPER PROTECTION

- A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.
  - 1. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.
- B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components must initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display must identify tamper alarms and indicate locations.

## 2.6 CABLES

- A. Supply manufacturer-recommended cable types for all devices including:
  - 1. Card readers & devices
  - 2. Electronic locks
  - 3. Door Contacts
  - 4. Motion Sensors
  - 5. Latch Detectors
  - 6. Local Alarm Sounders

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Comply with ANSI/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."
- B. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project Drawings and Specifications and publish as Project planning documents for review.
  - 1. Record setup data for control station and workstations.

2. For each Location, record setup of Controller features and access requirements.
  3. Propose start and stop times for time zones and holidays and match up access levels for doors.
  4. Set up groups, facility codes, linking, and list inputs and outputs for each Controller.
  5. Assign action message names and compose messages.
  6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
  7. Prepare and install alarm graphic maps on VGUI at Master Control Stations.
  8. Discuss badge layout options, design badges.
  9. Complete system diagnostics and operation verification.
  10. Prepare a specific plan for system testing, startup, and demonstration.
  11. Develop acceptance test concept and, on approval, develop specifics of the test.
  12. Develop cable and asset management system details, input data from construction documents. Include system schematics and Visio Technical Drawings.
- C. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

### 3.3 GROUNDING

- A. Comply with Division 28 Section "Grounding and Bonding for Safety & Security Systems."
- B. Bond shields and drain conductors to ground at only one point in each circuit.

### 3.4 INSTALLATION

- A. Install all devices in strict accordance with manufacturer's instructions.
  1. The Contractor will configure System Administration
  2. Contractor will implement Badge Layout Creation
  3. Contractor will perform Screen or Forms Creation
  4. Contractor will perform Graphical Map Creation
  5. Application Programming Interfaces
  6. Contractor will perform Data Import
  7. Contractor Install and Configure the System Tape Backup
  8. Contractor Install and Configure Client workstations
  9. Contractor Configure Archiving
  10. Contractor Configure Badge Layout Creation Module
  11. Contractor Configure Cardholder Database
- B. Access Control Software:
  1. Contractor will configure Time zones
  2. Contractor will configure Access Levels
  3. Contractor will configure Access Groups
  4. Contractor will configure Holidays
  5. Contractor will implement First Card Unlock
  6. Contractor will configure Field Hardware Communications
  7. Contractor will configure Area Control
  8. Contractor will perform Field Hardware Configuration
  9. Contractor will configure Cardholder Use Limits
  10. Contractor will configure Extended Individual Strike Times
  11. Contractor will configure Extended Individual Door Held Open Times

12. Contractor will configure Extended, on Demand, Door Held Open Times
13. Contractor will configure Guard Tour
14. Contractor will configure Security Clearance Levels
15. Contractor will configure Elevator Control:

C. Conductor terminations in control panels and panels to be made on terminal strips with a separate point for each conductor. All such strips to be number identified as shown in wiring diagram attached to inside of door of control panel. Connect wiring neatly to terminals strips. Place wire neatly in Panduit type wire channels. Set up termination of cabling so that section of the system may be isolated for servicing.

D. Wiring

1. Wiring shall run continuous from device to device. Place wiring in termination and control panels in Panduit wiring channels and form in a neat professional looking manor. No splices shall be permitted except at terminal blocks installed in termination cabinets. The use of wire nuts or crimp type connectors shall not be permitted unless specifically approved by the Owner. Wiring shall be in metal conduit. Where shielded wire is used it shall be connected to an earth ground at the main panel. Data and signal wiring shall be run with shielded wiring. Minimum wire size shall be #18 min.
2. Any devices installed in the ABSL-3 facility shall be properly sealed to maintain air pressure standards.

E. Termination Cabinets

1. Where termination cabinets are used, they shall be installed on walls or in walls in finished areas. Each termination cabinet shall have a hinged cover with a lock installed flush with the cover. These locks shall be keyed alike. Install a white 3/4" plywood backboard inside. Each termination cabinet shall be marked with a sign with the words "sec. termination cabinet" attached to the front cover. This sign shall be constructed from red laminated plastic with 1/4" white engraved letters.

### 3.5 SYSTEM SOFTWARE

- A. Develop, install, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner.
- B. The Contractor will provide all software configuration files for all and any software utilized on the project
- C. Access Control Reports: Configure any and all reports available and requested.
- D. Contractor configure Alarm Attributes: The System Administrator shall have the ability to configure how the SMS handles the annunciation of alarms on an individual basis.
  1. Contractor will configure Alarm-Event Mappings
  2. Contractor will configure System Downloads:
  3. Contractor will configure Card Reader Options
  4. Contractor will configure Input Control Module (ICM) Options
  5. Contractor will configure Entry or Exit Delay
  6. Contractor will configure Intelligent System Controller Options
  7. Contractor will configure Basic Integrated Intrusion Functionality
  8. Contractor will configure Alarm Monitoring
  9. Contractor will perform Alarm Annunciation Configuration

10. Contractor will configure Real-Time, Dynamic Graphical Maps:
  - a. Support graphical maps that display device or group status, function lists and video cameras dynamically in real-time. The maps may be configured to appear on command or when specified alarms are selected for acknowledgment. Map device icons shall have the ability to dynamically change shape and/or color to reflect the current state of the device. The SMS shall indicate if the field hardware is not operating with the most current version of firmware.

### 3.6 FIELD QUALITY CONTROL

- A. Contractor: 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. LAN Cable Procedures: If the Category cable is provided as a part of this bid, the Contractor shall inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 6 or 6A tester. Test for faulty connectors, splices, and terminations. Test according to TIA -568-1, "Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA-568-B. Comply with Section 27 1500 Horizontal Cable.
  2. Test each circuit and component of each system. Tests must include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup must be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
  3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.
- C. Remove and replace malfunctioning devices and circuits and retest as specified above.

### 3.7 CABLE PROTECTION

- A. Cables shall not be exposed to paint, paint remover, water, or any liquids which may degrade the performance of the cable, void the manufacturer's warranty, alter the flame and/or smoke characteristics of the cable, or obscure the flame rating designations printed on the jacket. Cables exposed to paint, paint remover, water, or any liquid shall be replaced by the Contractor.

### 3.8 DEMONSTRATION

- A. Prior to contract completion, the Contractor shall provide comprehensive demonstration of the fully functioning system to Owner/Architect.
  1. Notify the Contractor, Architect and Owner in writing 30 days prior to scheduling the demonstration.



### 3.9 TRAINING

- A. The Contractor is required to perform a minimum of 20 hours of training, broken up into two eight-hour training sessions allowing for the different government branches to attend at their convenience. The final four hours will be reserved as a follow-up session to correct misunderstandings, or for those who were previously unable to attend. Training shall cover all system functions, including (at a minimum) the following:
1. System setup.
  2. System operation.
  3. Credential creation.
  4. Records keeping.

### 3.10 CLOSEOUT

- A. Provide an additional 16 hours of on-site training, reprogramming, adjustment, and setup after final acceptance at the direction of the Owner for adjustments to the system.

END OF SECTION

## SECTION 282300 – VIDEO SURVEILLANCE SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other sections of Division 28.
- B. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27.

#### 1.2 DRAWINGS

- A. The drawings show the general arrangement and extent of the work only. Determine the exact location and arrangement of all parts as the work progresses.
- B. In all details, the work shall be subject to the Owner's direction and approval. All work shall conform to its surroundings in best possible manner.

#### 1.3 DESCRIPTION

- A. The work required under this section of the specifications consists of the installation of a complete video management system (VMS) for the Campbell Library. This system shall be complete in every sense. It shall include all wiring, raceways, power supplies, software, configuration, testing, start up, commissioning, training, and spare parts.
- B. The successful Contractor shall provide an upgrade to the latest version of the Floor plans showing the entire area with room numbers, locations for each device, riser diagram, point to point diagram, symbol of all devices being used. Indicate system components, size of components, location and provide full schematic of wiring system showing building, operation details.
- C. The successful Contractor shall provide training on the VMS platform to the appropriate personnel as required to optimize the use of this product.
  - 1. The video system shall be integrated with the Access Control System (ACS) to allow the operators to easily integrate the sense and identification functions of both systems as one.
- D. Major raceway, outlet boxes and 120-volt power (including power to the outdoor cameras) shall be provided by Division 26 contractor.
- E. Specifications include, but not limited to, the following:
  - 2. Video cameras, housings, & mounts.
  - 3. Video monitoring station.
  - 4. Video Server
  - 5. Power Supplies (as needed)

6. All control wiring and power wiring.
  7. All miscellaneous raceways necessary to ensure cable protection.
- F. Provide all equipment and accessories for a complete camera system(s) as described herein and as shown on the plans.
- G. All equipment, wiring, and operation of the system shall comply with local and state ordinances and UL Standards for Safety.

#### 1.4 QUALITY ASSURANCE

- A. Installation shall comply with all applicable codes and standards.
- B. All equipment shall be new, in current production, the standard products of an acceptable manufacturer.
- C. The manufacturer shall guarantee the availability of parts for a minimum of (5) years from date of shipment. All equipment and software shall be the latest version available from the manufacturer.
- D. The manufacturer shall be able to demonstrate the features, functions, operating characteristics and clarity of picture to the Owner.
- E. The system shall be installed by a factory authorized, and trained, Security System Installer.
- F. Maintenance and repair service shall be available locally and within (4) hours of notification for emergency conditions.
- G. Design Verification and Acceptance
1. The Contractor is responsible for verifying the accuracy of the system designs documented in the Specification and Drawings and acceptance of responsibility. Any issues, discrepancies substitutions, or exceptions to the contract documents by the Contractor shall be communicated to the Technology Consultant prior to the purchase of any equipment or materials by way of the Shop Drawings Submittal process. Upon approval of the Contractor's Shop Drawing Submittal by the Owner's designated representative, or if the Contractor fails to submit Shop Drawings, the Contractor shall assume all responsibility for supplying such materials and taking such actions as to satisfy the full intentions of the contract documents without claim for additional compensation. This shall include providing any incidental equipment, Installation Materials and labor needed in order to result in a complete and operable system, even if such equipment, materials or labor are not listed in this Specification. Exceptions include Owner-requested changes, unexpected field issues due to work by other trades, or schedule changes initiated by others.
- H. Equipment and accessories furnished under the terms of this specification shall be the standard products of manufacturers regularly engaging in the manufacture of this type of product(s) for a period of at least three years.
- I. All products within this bid, deemed by the manufacturer as "End of Life" at the time of installation shall be replaced with the next generation replacement in kind, at no additional cost to the Owner.

#### 1.5 WARRANTY

- A. The system shall be warranted for a period of one year from date of Owner acceptance.

- B. Refer to Division 01 for additional warranty requirements.

## 1.6 SUBMITTALS

- A. Floor plans showing the entire area with room numbers, locations for each device, riser diagram, point to point diagram, symbol of all devices being used. Indicate system components, location and provide full schematic of wiring system showing building, operation details.
- B. Submit mounting and housing information for each camera for approval to the Owner's Representative. Submit manufacturer's installation instructions.
- C. Submit manufacturer's descriptive literature, operating instructions, and maintenance and repair data.
- D. Have installer submit upon completion of system verification a point-by-point checklist indicating the date and time of each item inspected and issue a certificate confirming that the inspection has been completed and the system is installed and functioning in accordance with the specifications.
- E. Do not start construction until drawings and submittals have been reviewed by Technology Consultant and Owner's Safety and Security Department.

## 1.7 SYSTEM DESCRIPTION

- A. The purpose of the system is to provide security surveillance and recording of areas shown on drawings.
- B. Operation
  - 1. Camera Operating System:
    - a. Cameras shall be located in appropriate housings and installed at the location to be monitored.
    - b. Monitors will be located at the designated monitoring point as shown on drawings.
- C. The system shall be connected to panic/intrusion devices as required for alarm/event recording and to direct camera to a preset location.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. The products herein are based on the Lenel VMS software, which the Owner has standardized on and no exceptions will be allowed for that product. For cameras and ancillary products, a "Basis of Design" will be noted with approved alternate manufacturers; in as much as that product meets all requirements.
  - 1. The "Basis of Design shall serve as a "minimum standard" of functionality. Contractor shall be responsible to provide cameras that will have the appropriate camera type and lens configuration for optimum viewing.

- B. Any substitutions must meet all requirements of Prior Approval, as outlined in the contract documents. Substitutions that meet Prior Approval requirements must be listed as an Alternate by addendum.

## 2.2 EQUIPMENT

### A. Video Storage

- 1. Provide sufficient storage for each camera shown within the current package plus 25% expansion capability.
  - a. Maintain a minimum of 30 days storage capacity for the cameras on each NVR, based on:
    - 1) 16CIF minimum
    - 2) 3.5 fps when no motion
    - 3) 15 fps under motion
  - b. Basis of Design: LenelS2 NVR.

### B. 360° cameras

- 1. 360° cameras shall be:
  - a. 12-megapixel
  - b. 360° field of view
  - c. 1.45mm f/2.2 Lens
  - d. Remote Zoom & Focus
  - e. ONVIF compliant
  - f. 2000x2000-2992x2992 Active Pixels
  - g. Tamper resistant/weather resistant housing
  - h. Up to 30fps image rate (0.13 lux (F2.2) in color mode & 0 lux (F2.2) monochrome
  - i. Electronic Shutter Control
  - j. Axis, Model# P3719-PLE

### C. Interior Fixed Dome IP Cameras

- 1. Interior Fixed Dome IP Cameras shall be:
  - a. 4-megapixel resolution
  - b. Available in 3-9mm F1.3, 4.3-8mm F1.9, or 9-22mm F1.6
  - c. Remote Zoom & Focus
  - d. Wide Dynamic Range (WDR)
  - e. ONVIF compliant
  - f. 1280x720-2592x1944 Active Pixels
  - g. Tamper resistant housing
  - h. Up to 30fps image rate
  - i. Axis, Model# P3268-LV

### D. Dual Sensor Cameras

- 1. Dual sensor cameras shall be:
  - a. Dual Sensor cameras shall be:
  - b. 2 x 5-megapixel resolution
  - c. Available in 3-9mm F1.3, 4.3-8mm F1.9, or 9-22mm F1.6
  - d. Remote Zoom & Focus
  - e. Wide Dynamic Range (WDR)
  - f. ONVIF compliant
  - g. 1280x720-2592x1944 Active Pixels

- h. Tamper resistant housing
- i. Up to 30fps image rate
- j. Axis Model# P4707-PLVE.

E. Monitoring Station shall be:

- 1. Dell XPS Tower Series
- 2. Intel Core i7-9700
- 3. Microsoft Windows 10 (64 bit)
- 4. 32GB DRAM
- 5. 1 TB Hard Drive (SSD)
- 6. DVD-read/writable
- 7. High output graphics card
- 8. APC Smart-UPS 1500 LCD UPS for each PC and the associated monitor.
  - a. Equals by SurgeX, Tripp Lite, CyberPower, Minuteman

F. Monitors shall be:

- 1. 24" Monitor shall be Dell Model U2418HX, complete with the following features/options:
  - a. 1920 x 1200 @60Hz native resolution
  - b. 16.7 million colors
  - c. Front Panel Controls
  - d. Contrast ratio 8,000,000:1 (dynamic mode)
  - e. 2 x HDMI inputs, VGA
  - f. 120-volt operation

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. The systems shall be installed and configured per the drawings and as specified herein.
- B. The camera setup shall be setup, aimed, and focused in coordination with the Owner and Technology Consultant.
  - 1. Contractor shall configure the camera, transceiver (where required), and power supply to optimize the installation process. The power supply shall be selected and configured to accommodate all devices as required to meet the design requirements.
  - 2. Where cameras are installed such that, the distance is too great to meet the Cat 6 100-meter limit, the Contractor shall utilize a combination of twisted pair for power and Multimode fiber for connectivity.
- C. Installation shall be accomplished in a professional manner by qualified personnel regularly engaging in and experienced in this type of work for a period of at least 5 years.
  - 1. All Category cabling shall be provided in accordance with the Division 27 specifications from the base building bid package.
  - 2. The successful bidder shall coordinate cable, patch panel, patch cords, etc. with the on-site Division 27 contractor for installation within the telecom rooms as required.
- D. All control locations shall have complete full function control of each camera.
- E. All fixed lens cameras to be adjusted to the satisfaction of the Owner.

- F. Junction boxes to be provided as required to properly install cameras.
- G. System shall be completely integrated with the existing VMS and configured for full operation. Confirm final requirements with Owner and Technology Consultant.
- H. All custom software shall become the property of the Owner upon final payment with no special or hidden keys preventing updating of the software.
- I. Licensing: the system shall be bid to the Owner as a "Turn-Key" system. It shall contain all and any necessary user licenses (at no additional cost) as required for a fully functioning system as specified.
- J. PC's, monitors, power supplies, NVR etc. to be securely rack-mounted in monitoring locations.
- K. All wiring shall be installed in conduit or raceway in accordance with UL and manufacturer's recommendations. Any cabling not installed within metal conduits shall be plenum rated. All tie-wraps, accessories, components, cables, etc. shall be UL labeled for installation in an environmental air plenum. All installations shall comply with State of New Jersey requirements. This plenum rating requirement shall supersede any catalog numbers listed herein.
- L. Labeling
  - 1. Attach to the interior of each control panel a clear plastic holder in this holder place a typed list of the zone numbers and/or area for each camera, the type of camera and all accessories (make and model numbers) with any other information required for ordering replacements. This list shall be typed on 8-1/2" x 11" paper provide a copy of these list(s) on CD/DVD in Microsoft Word compatible format to the Owner.
  - 2. Where junction boxes are installed in concealed areas in the ceiling the box shall have the words "sec. system" attached to the cover. At the access point to the junction box there shall be a sign with 1/4" letters attached to the T-bar grid, this sign shall state "sec. terminal" and shall be constructed from red laminated plastic with white engraved letters. Where the ceiling is solid, the sign shall be attached at the access door nearest to the junction box.
- M. Conduits
  - 1. Minimum conduit size for multiple conductor runs shall be 1".

### 3.2 SYSTEM VERIFICATION

- A. The security equipment supplier shall make a thorough inspection of the complete installed system including all components to insure the following:
  - 1. Complete and functional system.
  - 2. Underwriters Laboratories requirements.
  - 3. Installed in accordance with manufacturer's recommendations.
    - 1) Regulations covering supervision of components are adhered to.

### 3.3 TESTING AND GUARANTEE

- A. Guarantee all wiring and equipment free from inherent mechanical and electrical defects for a period of one (1) year from the date of the installation and acceptance of the Owner. Upon notification of request for warranty service, respond within four hours. If the problem cannot be corrected at that time, present a written plan of correction to the Owner's Plant Operations and

Maintenance personnel detailing the problem, the course of action, and a time schedule for correction.

- B. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Submit prior to request for final payment.
- C. Test each camera type for its specific capabilities and verify integration with the LeneIS2 system.
- D. Provide 16 hours of on-site instruction to the Owner with regard to proper use and operation of the system. Provide class syllabus as a submittal. Also provide video system operations and maintenance instructions.
- E. Provide an additional 16 hours of on-site training, reprogramming, adjustment, and setup after final acceptance at the direction of the Owner for adjustments to the system.
- F. Operations and Maintenance Manual: Shall include manufacturers data sheets; maintenance and operation information sheets; as-built drawings showing the final Owner's room numbers; a separate sheet listing all the zones, and other devices, their locations and the exact and specific function of the device as to what it actually is monitoring or operating and any other information available that pertains to the system construction, operation, or maintenance. A copy of this listing of all the zones, or other devices and their functions shall be provided on a CD or DVD in Microsoft Word format. As-built drawings shall be provided on a CD or DVD.

END OF SECTION



## **SECTION 28 30 00 - FIRE ALARM AND DETECTION SYSTEMS - ADDRESSABLE - HORN**

### **PART 1 - GENERAL**

#### 1.01 REFERENCE

- A. Refer to Section 26 00 00 for requirements which are applicable to this section. All work required is not limited to this section.

#### 1.02 WORK INCLUDED

- A. Provide labor, material, equipment, and supervision necessary to install a complete electrically supervised microprocessor based, fully addressable type system as outlined in this section.
- B. Equipment by EST, Notifier, Siemens or Simplex is acceptable provided that design criteria is satisfied.
- C. It is the intent of this specification and accompanying drawings to require the contractor and/or supplier of equipment and devices to provide a complete code compliant system which will obtain, as a minimum, the approval of the AHJ. Different suppliers may have devices which differ between each other and as such all devices necessary for approval shall be included in the scope of work whether specifically identified or not.
- D. Horns shall be audible as required by code in all spaces above ambient. Devices provided by manufacturers shall be selected to provide audibility with either additional horns or higher dB devices as necessary to achieve such approval.
- E. Strobes shall be visible as required by code in all spaces to meet requirements of the AHJ.
- F. All fire alarm system components are to be appropriately rated for the environment in which they are being installed. The fire alarm vendor is responsible for UL Listed device selections. Consideration shall be given to, but not be limited to, ambient temperature, water infiltration, dust infiltration, and humidity.
- G. In order to meet the approval of the AHJ, it may be necessary to add additional devices that are not indicated on the drawings. The contractor is to allow for 15 additional devices and wiring.

#### 1.03 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. Include voltage drop calculations for notification-appliance circuits.
  - 5. Include battery-size calculations.

6. 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.
  7. Include performance parameters and installation details for each detector.
  8. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  9. 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. Submit drawings to the local authority for permit and approval. Submit approved drawings to consulting engineers and to owner's insurance company and obtain approval prior to construction. All requirements for above approval are to be included with the work.
  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; Level III minimum.
    - c. Licensed or certified by authorities having jurisdiction.

#### 1.04 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. Control of System: By the Fire Alarm Control Panel (FACP).
- B. System Supervision: Automatically detect and report open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
- C. Priority of Signals: Automatic alarm response functions resulting from an alarm signal from one zone or device are not altered by subsequent alarm, supervisory, or trouble signals. An alarm signal is the highest priority. Supervisory and trouble signals have second- and third-level priority. Higher-priority signals take precedence over signals of lower priority, even when the lower-priority condition occurs first. Annunciate and display all alarm, supervisory, and trouble signals regardless of priority or order received.
- D. Noninterference: A signal on one zone shall not prevent the receipt of signals from other zones.
- E. System Reset: All zones are manually resettable from the FACP after initiating devices are restored to normal.
- F. Transmission to Remote Alarm Receiving Station: Automatically route alarm, supervisory, and trouble signals to a remote alarm station by means of a digital alarm communicator transmitter and telephone lines.
- G. System Alarm Capability during Circuit Fault Conditions: System wiring, and circuit arrangement prevent alarm capability reduction when an open circuit, ground or wire-to-wire short occurs, or an open circuit and a ground occur at the same time in an initiating device circuit, signal line circuit, or notification-appliance circuit.
- H. Loss of primary power at the FACP initiates a trouble signal at the FACP and the annunciator. An emergency power light is illuminated at both locations when the system is operating on the secondary power supply.
- I. Basic Alarm Performance Requirements: Unless otherwise indicated, operation of a manual station, automatic alarm operation of a smoke or flame or heat detector, or operation of a sprinkler flow device initiates the following:
  1. Notification-appliance operation (exterior bell/ strobe only operates with sprinkler flow devices).

2. Identification at the FACP and the remote annunciator of the device originating the alarm.
  3. Transmission of an alarm signal to the remote alarm receiving station.
  4. Unlocking of electric door locks in designated egress paths.
  5. Release of fire and smoke doors held open by magnetic door holders.
  6. Recall of elevator(s).
  7. Shutdown of fans and other air-handling equipment serving zone when alarm was initiated.
  8. Closing of smoke dampers in air ducts of system serving zone where alarm was initiated.
  9. Recording of the event in the system memory.
  10. \*Recording of the event by the system printer.
- J. Alarm Silencing, System Reset and Indication: Controlled by switches in the FACP (and the Remote Annunciator).
1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
  2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
  3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.
- K. Water-flow alarm switch operation initiates the following:
1. Notification-appliance operation.
  2. Flashing of the device location-indicating light for the device that has operated.
  3. Notification-appliance operation on exterior.
- L. Operating a heat detector in the elevator shaft shuts down elevator power by operating the shunt trip in a (all) circuit breaker(s) feeding the elevator(s). Refer to 26 00 00 for sequence of operation.
- M. Water-flow alarm for connection to sprinkler in an elevator shaft and elevator machine room shuts down elevators associated with the location without time delay.
1. A field-mounted relay actuated by the fire detector or the FACP closes the shunt trip circuit and operates building notification appliances and annunciator.
- N. Smoke detection for zones or detectors with alarm verification initiates the following:
1. Audible and visible indication of an "alarm verification" signal at the FACP.
  2. General alarm if the alarm is verified.
  3. Cancellation of the FACP indication and system reset if the alarm is not verified.
- O. Sprinkler valve-tamper switch operation initiates the following:
1. A supervisory, audible, and visible "valve-tamper" signal indication at the FACP and the annunciator.
  2. Flashing of the device location-indicating light for the device that has operated.
  3. Transmission of supervisory signal to remote alarm receiving station.
- P. Fire-pump power failure, including a dead-phase or phase-reversal condition, initiates the following:
1. A supervisory, audible, and visible "fire-pump power failure" signal indication at the FACP and the annunciator.
  2. Transmission of trouble signal to remote alarm receiving station.
- Q. Low-air-pressure switch operation on a dry-pipe or pre-action sprinkler system initiates the following:

1. A supervisory, audible, and visible "sprinkler trouble" signal indication at the FACP and the annunciator.
  2. Flashing of the device location-indicating light for the device that has operated.
  3. Transmission of trouble signal to remote central station.
- R. Remote Detector Sensitivity Adjustment: Manipulation of controls at the FACP causes the selection of specific addressable smoke detectors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings. Same controls can be used to program repetitive, scheduled, automated changes in sensitivity of specific detectors. Sensitivity adjustments and sensitivity-adjustment schedule changes are recorded in system memory and are printed out by the system printer.
- S. Removal of an alarm-initiating device or a notification appliance initiates the following:
1. A "trouble" signal indication at the FACP and the annunciator for the device or zone involved.
  2. Transmission of trouble signal to remote alarm receiving station.
- T. FACP Alphanumeric Display: Plain-English-language descriptions of alarm, supervisory, and trouble events; and addresses and locations of alarm-initiating or supervisory devices originating the report. Display monitoring actions, system and component status, system commands, programming information, and data from the system's historical memory.

## PART 2 - PRODUCTS

### 2.01 CONTROL PANEL

- A. Fire Alarm Panel shall be surface mounted where shown on the drawings, with the following items.
- UL Listed
  - Modular, microprocessor-based
  - Addressable locations of all devices
  - Zoned Visual Alarm and Trouble Indicators
  - Automatic Ground Detection
  - Lamp Test
  - Supervisory Voltage and Current Meters
  - Double Supervision
  - Field Programmable Fan Relays
  - Supervise Signal Circuit Modules
  - Annunciator Contacts by Zone
  - Dead Front Construction
  - Battery backup

### 2.02 SMOKE DETECTORS

- A. Furnish and install where shown on the drawings UL listed smoke detectors. Detector shall be solid state photoelectric type and shall operate on the light scattering, photo diode principle. Detector shall have an integral fixed temperature heat detector rated at 135°F.
- B. Detector shall be analog-addressable type, individually monitored at the FACP for

calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

#### 2.03 HORN/ STROBE

- A. Combination device with factory integrated audible and visible devices in a single mounting assembly. Horn shall be electric vibrating polarized type which produces 90 dB measured 10'-0" from the horn. Strobe shall be self-synchronizing, Xenon strobe lights with clear lens and rated light output of 15, 30, 60, 75, or 110 candelas.

#### 2.04 STROBE

- A. Self-synchronizing, flush wall mounted, red housing, white letters, UL 1638 and UL 1971 compliant 15, 30, 60, 75, or 110 candelas as appropriate, mounted on single-gang box, clear Lexan flash tube enclosure.

#### 2.05 MINI-HORN/ STROBE

- A. Similar to Horn/ Strobe except 110 candela strobes, 75 dB measured at 10'-0".

#### 2.06 FIRE ALARM STATIONS

- A. Fire Alarm Stations shall be semi-flush mounted, non-code break glass type. Finish shall be red with white letters.
- B. Stations shall be addressable.

#### 2.07 HEAT DETECTORS

- A. Heat Detectors, furnished and installed where indicated on the drawings, shall be combination type, actuated by either a fixed temperature of 135°F or rate of rise of temperature that exceeds 15°F per minute.
- B. Detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

#### 2.08 DUCT SMOKE DETECTORS

- A. Furnish where indicted on the drawings or required elsewhere in the specifications air duct smoke detectors. Duct smoke detectors are to be furnished by the electrical contractor, installed by the mechanical contractor, and wired to the fire alarm system by the electrical contractor. They shall integrate photoelectric, ionization and heat sensing technologies for optimum detection accuracy and to prevent unwanted alarms. Auxiliary contacts shall be provided to shut down the air handling unit fan. The detector shall output to a remote alarm indicator.
- B. Detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

## 2.09 REMOTE DEVICE LOCATION-INDICATING LIGHTS AND IDENTIFICATION PLATES

- A. Device shall contain LED indicating light near each smoke detector that may not be readily visible, and each sprinkler water-flow switch and valve-tamper switch. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identified, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

## 2.10 WATERFLOW SWITCHES - TAMPER SWITCHES

- A. Water flow Switches and tamper switches shall be furnished and installed by the sprinkler contractor. Refer to sprinkler drawings and specs for locations and quantities.
- B. Switches shall be addressable. Electrical contractor shall wire to fire alarm system and to exterior bell/ strobe.
- C. Switches are supplied with two contacts, one for connection to fire alarm system and one for exterior bell/ strobe.

## 2.11 DRY PIPE SYSTEM

- A. Furnish and install an air pressure monitoring alarm which shall provide a trouble signal if the dry pipe system air pressure falls outside its allowable range.

## 2.12 KITCHEN HOOD INTERLOCK

- A. Furnish and install an interlock with the Kitchen Hood Extinguishing System which shall alarm the system if the Kitchen Hood goes into alarm.

## 2.13 TELEPHONE AUTO DIALER

- A. Furnish and install where indicated on the drawings or required elsewhere in the specifications a digital-type telephone auto dialer. The dialer shall call and notify a preprogrammed telephone number when in the alarm mode.

## 2.14 MAGNETIC DOOR HOLDERS

- A. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Electromagnet shall require no more than three watts to develop 25 foot-pounds of holding force.
- B. Material and finish shall match door hardware.
- C. Units are to be rated for 24-volt AC, or DC operation.

## 2.15 ADDRESSABLE INTERFACE DEVICE

- A. Device shall be Microelectronic monitor module listed for use in providing a multiplex system address for listed fire and sprinkler alarm-initiating devices with normally open contacts.
- B. Integral Relay shall be capable of providing a direct signal to the elevator controller to initiate

elevator recall or to a circuit-breaker shunt trip for power shutdown.

## 2.16 ANNUNCIATOR

- A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also, duplicate manual switching functions of the FACP, including acknowledging, silencing, reset, and test.
- B. Mounting: Flush cabinet, NEMA 250, Class 1.
- C. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

## 2.17 SOUNDER BASE

- A. Audible device to which smoke detector is mounted. 94dBA average sound output is to be synchronized throughout.

## 2.18 EXTERIOR BELL AND STROBE

- A. Weatherproof device(s) with factory integrated audible and visible devices in a single mounting assembly. Bell shall be 24-volt (nominal) which produces 83 dB measured at 10'-0". Strobe shall be Zenon type with clear lens and rated light output of 75 candelas or as required by the local Fire Marshal. Strobe shall be provided with clear weatherproof guard for physical protection and heater system to assure operation to -40°F.

# PART 3 - EXECUTION

## 3.01 SYSTEM OPERATION

- A. Operation of any manual or automatic device shall cause all signals and strobes to sound. The annunciator will identify the specific location of the alarm initiation. Control and contacts for the building system shall function as required. Door hold opens shall be released. Door locks will be opened.

## 3.02 WIRING

- A. All wiring shall be run in conduit in exposed areas or Fire Alarm MC Cable in concealed spaces and shall be installed as recommended by the system manufacturer. Provide duct alternate for use of type FPLP plenum rated fire alarm cable.
- B. Initiating device circuits are to be Class B (two-wire using NO contact initiating devices and an end of line resistor).
- C. Notification appliance circuits shall have polarized devices wired in parallel and be equipped an end of line resistor.

## 3.03 EQUIPMENT INSTALLATION

- A. Smoke detectors indicated on the drawings shall be located in the occupied space. A similar device layout shall be duplicated above suspended ceilings and/ or below raised floors as outlined in NFPA 72 for return air plenums.
- B. Connect the FACP with a disconnect switch with lockable handle or cover. Provide circuit label as per NFPA 72 requirements.
- C. Manual Pull Stations: Mount semi-flush in recessed back boxes.
- D. Water-Flow Detectors and Valve Supervisory Switches: Connect for each sprinkler valve station required to be supervised. Connect to exterior bell/ strobe (bell/strobe only operates with water flow).
- E. Ceiling-Mounted Smoke Detectors: Not less than 0'-4" (100mm) from a side wall to the near edge. For exposed solid-joist construction, mount detectors on the bottom of joists. On smooth ceilings, install not more than 30'-0" (9m) apart in any direction.
- F. Wall-Mounted Smoke Detectors: At least, 0'-4" (100mm), but not more than, 1'-0" (300mm) below the ceiling.
- G. Smoke Detectors near Air Registers: Install no closer than 5'-0" (1,520mm).
- H. Duct Smoke Detectors: Comply with manufacturer's written instructions.
  - 1. Verify that each unit is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  - 2. Install sampling tubes so they extend the full width of the duct.
  - 3. Install detectors in supply and return for all units 2,000 CFM and greater. Coordinate with mechanical documents for all units requiring detection. Note that one detector may be installed in lieu of two where directed by the authority having jurisdiction when units are between 2,000 CFM and 15,000 CFM.
- I. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- J. FACP and Auxiliary Booster Panels: Surface mount with tops of cabinets not more than 6'-0" (1,830mm) above the finished floor. Provide smoke detection for room in which the panel is located.
- K. Annunciator: Install with the top of the panel not more than 6'-0" (1,830mm) above the finished floor.
- L. Provide separate zone for each floor, not to exceed 20,000 square feet, length not to exceed 200'-0" in any direction.
- M. Provide where indicated on drawings, 15 candela horn/ strobes or strobes in non-sleeping rooms up to 20' x 20'. Provide 30 candela horn/ strobes or strobes in non-sleeping rooms up to 30' x 30'. Provide 110 candela horn/ strobes in all other spaces where indicated on drawings.
- N. Sounder bases are to be used for all smoke detectors within sleeping areas.
- O. Exterior Bell and Strobe: Install on exterior wall above the Fire Department sprinkler connection at a height of 12'-0" unless directed otherwise by the local Fire Marshal. Coordinate with fire protection contractor.
- P. For all magnetic door hold-open devices, a smoke detector is to be provided within 5'-0" of each doorway on both sides of the doorway. Coordinate with architect/ owner for magnetic door holder material, finish and mounting.

### 3.04 SERVICE

- A. A service contract shall be made available to the owner after the one-year warranty expires.
- B. A complete set of reproducible as-builts, showing installed wiring and color coding and wire



tag notations for exact locations of all installed equipment, specific interconnections between all equipment shall be provided for the system.

### 3.05 TESTING

- A. Perform test of system according to procedures outlined in NFPA 72. Correct deficiencies, as necessary. Provide written record of inspections, tests, and test results in the form of a test log.

END OF SECTION