# Tenant Improvement - DMH
## Robert E. Lee Building (First, Second, Tenth, Eleventh, and Twelfth Floors)
## (Office of Capitol Facilities)
## (Department of Finance and Administration)
## Jackson, Mississippi

GS# 354-050 (PP003)

Architect's Project No. 2007

14 September 2021

OWNER
Bureau of Building, Grounds, and Real Property Management
501 N. West Street
1401 Woolfolk Building, Suite B
Jackson, Mississippi 39201

USING AGENCY
Office of Capitol Facilities
Jackson, Mississippi 39201

ARCHITECT
Burris/Wagnon Architects, P.A.
500L East Woodrow Wilson Avenue
Jackson, Mississippi 39216

MECHANICAL ENGINEER
Engineering Resource Group
350 Edgewood Terrace Drive
Jackson, Mississippi 39206

ELECTRICAL ENGINEER
Schultz & Wynne, P.A.
4523 Office Park Drive
Jackson, MS 39206

# Project Manual

**Set No.**

**GS# 354-050 (PP003)**
**Architect's Project No. 2007**

Tenant Improvement – DMH
Robert E. Lee Building (First, Second, Tenth, Eleventh, and Twelfth Floors)
(Office of Capitol Facilities)
(Department of Finance and Administration)
Jackson, Mississippi


OWNER

Bureau of Building, Grounds, and Real Property
501 North West Street
1401 Woolfolk Building, Suite B
Jackson, MS 39201
Phone: (601) 359-3621
Fax: (601) 359-2470

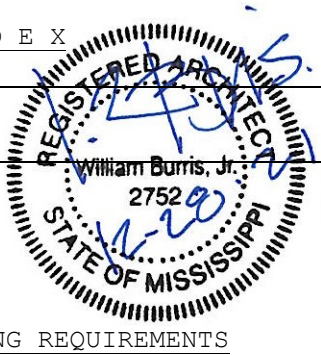
USING AGENCY

Office of Capitol Facilities
Jackson, Mississippi 39201

ARCHITECT

Burris/Wagnon Architects, P.A.
500L East Woodrow Wilson Avenue
Jackson, Mississippi 39216
Phone: (601) 969-7543
Fax: (601) 969-9374

# I N D E X



| SECTION NUMBER | | | PAGE NUMBER |
|---|---|---|---|
| TITLE SHEET | | | |
| INDEX | | | |
| DIVISION 0 – PROCUREMENT AND CONTRACTING REQUIREMENTS | | | |
| Section 00 1100 | – | Advertisement for Bids (BOB) | 1 |
| Section 00 2100 | – | Instructions to Bidders (BOB) | 2-5 |
| | | Bidder's Checklist (BOB) | 6 |
| Section 00 4200 | – | Proposal Form (BOB) | 7-8 |
| Section 00 5200 | – | Standard Form of Agreement Between the Owner and the Contractor (BOB) | 9-11 |
| Section 00 6100 | – | Contract Bond (BOB) | 12-13 |
| Section 00 6216 | – | Certificate of Insurance (BOB) | 14-15 |
| Section 00 6217 | – | Certificate of Insurance Instructions (BOB) | 16 |
| Section 00 6300 | – | Affidavit Certifying Payment to All Subcontractors (BOB) | 17-18 |
| Section 00 7200 | – | General Conditions (BOB) | 19 |
| Section 00 7300 | – | Supplementary Conditions (BOB) | 20-41 |
| Section 00 7339 | – | Minority Participation (BOB) | 42-44 |
| Section 00 7343 | – | Labor Requirements (BOB) | 45 |
| Section 00 8000 | – | Special Conditions (BOB) | 46 |
| Section 00 9000 | – | Addenda (BOB) | 47 |
| DIVISION 1 – GENERAL REQUIREMENTS | | | |
| Section 01 1000 | – | Summary of Work (BOB) | 1-2 |
| Section 01 2100 | – | Allowances (BOB) | 3 |
| Section 01 2300 | – | Alternates (BOB) | 3 |
| Section 01 2600 | – | Change Order Procedures (BOB) | 4-5 |
| Section 01 2973 | – | Schedule of Values (BOB) | 5 |
| Section 01 2976 | – | Applications for Payment (BOB) | 6 |
| Section 01 3100 | – | Project Coordination (BOB) | 6-7 |
| Section 01 3119 | – | Project Meetings (BOB) | 8-9 |
| Section 01 3216 | – | Progress Schedules (BOB) | 9 |
| Section 01 3217 | – | Network Analysis Schedule (BOB) | 10-12 |
| Section 01 3323 | – | Shop Drawings, Project Data, and Samples (BOB) | 12-14 |
| Section 01 4529 | – | Testing Laboratory Services (BOB) | 14-15 |
| Section 01 5000 | – | Construction Facilities and Temporary Controls (BOB) | 15-16 |
| Section 01 6000 | – | Substitutions and Product Options (BOB) | 17-18 |
| Section 01 7329 | – | Cutting and Patching (BOB) | 18 |
| Section 01 7400 | – | Cleaning (BOB) | 19 |
| Section 01 7500 | – | Starting of Systems (BOB) | 20 |
| Section 01 7700 | – | Contract Closeout (BOB) | 20-22 |
| Section 01 7800 | – | Project Record Documents (BOB) | 22-23 |
| Section 01 8000 | – | Special Requirements (BOB) | 24-25 |
| Additional Supplementary Conditions – Architect | | | 26-30 |

TECHNICAL SPECIFICATIONS

DIVISION 2 - SITE WORK


Section 02 05 00 - Demolition ..... 1-3
Section 02 41 16 - Structure Demolition (ALT #1) ..... 1-3


DIVISION 3 - CONCRETE

(None in the Work)

DIVISION 4 - MASONRY


Section 04 01 20.52 - Unit Masonry Cleaning (ALT. #1) ..... 1-11
Section 04 05 13 - Masonry Mortaring (ALT. #1) ..... 1-9
Section 04 21 29 - Terra Cotta Restoration (ALT.#1) ..... 1-6
Section 04 21 30 - Terra Cotta Fabrication (ALT. #1) ..... 1-5
Section 04 43 00 - Stone Masonry (ALT #1) ..... 1-11


DIVISION 5 - METALS


Section 05 50 00 - Miscellaneous Metals and Fabrications ..... 1-4


DIVISION 6 – WOOD, PLASTICS, AND COMPOSITES


Section 06 01 10 - Rough Carpentry ..... 1-3
Section 06 01 20 - Finish Carpentry & Millwork ..... 1-6


DIVISION 7 - THERMAL AND MOISTURE PROTECTION


Section 07 60 00 - Flashing and Sheet Metal (ALT. #1) ..... 1-5
Section 07 90 00 – Joint Protection (ALT. #1) ..... 1-5
Section 07 92 00 - Sealants and Caulking ..... 1-5


DIVISION 8 - OPENINGS


Section 08 11 13 - Hollow Metal Frames ..... 1-2
Section 08 14 00 - Wood Doors ..... 1-3
Section 08 14 33 - Stile and Rail Wood Doors ..... 1-5
Section 08 31 00 - Access Doors ..... 1
Section 08 41 26 - All-Glass Entrances ..... 1-6
Section 08 71 00 - Door Hardware ..... 1-21
Section 08 81 00 - Glass Glazing ..... 1-3


DIVISION 9 - FINISHES


Section 09 21 00 - Lath and Plaster ..... 1-6
Section 09 29 00 - Gypsum Board ..... 1-5
Section 09 30 00 - Ceramic Tile & Cut Natural Stone ..... 1-9
Section 09 51 00 - Acoustical Ceilings ..... 1-4
Section 09 65 00 - Resilient Flooring ..... 1-3
Section 09 68 00 - Carpet ..... 1-5
Section 09 84 00 - Acoustical Wall Treatment ..... 1-3
Section 09 91 00 - Painting ..... 1-6

DIVISION 10 - SPECIALTIES

Section 10 14 00 - Identifying Devices ..... 1-8
Section 10 21 13 - Stainless Steel Toilet Compartments ..... 1-5
Section 10 28 13 - Toilet Accessories ..... 1-2

DIVISION 11 - EQUIPMENT

Section 11 31 13 - Appliances ..... 1-2

DIVISION 12 - FURNISHINGS

Section 12 21 13.23 – Wood Horizontal Louver Blinds ..... 1-4
Section 12 24 13 – Window Shades ..... 1-5

DIVISION 13 - SPECIAL CONSTRUCTION

(None in this Work)

DIVISION 14 - CONVEYING EQUIPMENT

(None in this Work)

DIVISION 21 – FIRE SUPPRESSION

Section 21 13 00 - Fire Suppression Systems ..... 1-23

DIVISION 22 – PLUMBING

Section 22 11 16 - Domestic Water Piping ..... 1-11
Section 22 11 19 - Domestic Water Piping Specialties ..... 1-4
Section 22 13 16 - Sanitary Waste and Vent Piping ..... 1-10
Section 22 13 19 - Sanitary Waste Piping Specialties ..... 1-6
Section 22 40 00 - Plumbing Fixtures ..... 1-7

DIVISION 23 - HVAC

Section 23 00 10 - Mechanical General Provisions ..... 1-33
Section 23 00 20 - Mechanical Close-Out Requirements ..... 1-11
Section 23 00 30 - Demonstration and Training for Mechanical Systems ..... 1-6
Section 23 05 00 - Basic Mechanical Materials and Methods ..... 1-10
Section 23 05 13 - Motors and Controllers ..... 1-11
Section 23 05 19 - Meters and Gauges ..... 1-6
Section 23 05 23 - Valves ..... 1-12
Section 23 05 29 - Hangers and Supports ..... 1-14
Section 23 05 53 - Mechanical Identification ..... 1-7
Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC ..... 1-12
Section 23 07 13 - Duct Insulation ..... 1-11
Section 23 07 19 - Piping and Equipment Insulation ..... 1-16
Section 23 09 00 - Energy Management and Control System - General ..... 1-25
Section 23 09 13 - EMCS Basic Materials and Devices ..... 1-21
Section 23 09 16 - EMCS Operator Interfaces ..... 1-2
Section 23 09 19 - EMCS Field Panels ..... 1-11
Section 23 09 23 - EMCS Communication Devices ..... 1-4
Section 23 09 26 - EMCS Software and Programming ..... 1-24
Section 23 09 33 - EMCS Commissioning ..... 1-15

Section 23 21 13 - Hydronic Piping ..... 1-14
Section 23 21 16 - Hydronic Piping Specialties ..... 1-8
Section 23 31 13 - Metal Ducts ..... 1-23
Section 23 33 00 - Air Duct Accessories ..... 1-8
Section 23 37 00 - Air Outlets and Inlets ..... 1-4
Section 23 40 00 - Air Cleaning Devices ..... 1-4
Section 23 81 46 - Water-Source Unitary Heat Pumps ..... 1-8
Section 23 84 16 - Dehumidifiers ..... 1-4

DIVISION 25 – INTEGRATED AUTOMATION

(None in this Work)

DIVISION 26 - ELECTRICAL

Section 26 00 10 - General Provisions ..... 1-4
Section 26 00 20 - Codes & Standards ..... 1
Section 26 00 30 - Electrical Equipment/Material Submittals ..... 1-2
Section 26 01 00 - Basic Materials & Methods ..... 1-3
Section 26 01 10 - Raceways & Fittings ..... 1-7
Section 26 01 20 - Boxes & Enclosures ..... 1-4
Section 26 01 30 - Low-Voltage Conductors ..... 1-3
Section 26 01 50 - Enclosed Busway Systems ..... 1-2
Section 26 02 50 - Grounding & Bonding System ..... 1-3
Section 26 03 10 - Panelboards ..... 1-6
Section 26 03 50 - Dry-Type Transformers ..... 1-2
Section 26 04 10 - Wiring Devices ..... 1-6
Section 26 04 20 - Lighting Luminaires ..... 1-3
Section 26 04 50 - Equipment Electrical Services ..... 1-3
Section 26 05 10 - Telecommunication Raceway System ..... 1-3

DIVISION 27 - COMMUNICATIONS

(None in this Work)

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

Section 28 00 10 - General Provisions ..... 1-5
Section 28 00 30 - Electrical Equipment/Material Submittals ..... 1-2
Section 28 01 10 - Fire Detection and Alarm System ..... 1-18

DIVISION 31 - EARTHWORK

(None in this Work)

DIVISION 32 – EXTERIOR IMPROVEMENTS

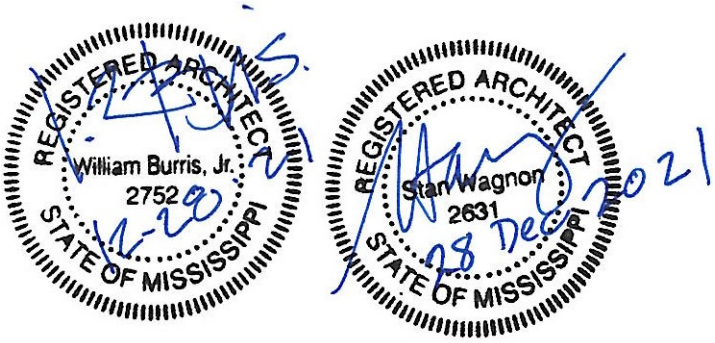
(None in this Work)

DIVISION 33 – UTILITIES

(None in this Work)

DIVISION 34 - TRANSPORTATION

(None in this Work)



DIVISION 35 – WATERWAY AND MARINE CONSTRUCTION

(None in this Work)

DIVISION 40 – PROCESS INTERCONNECTIONS

(None in this Work)

DIVISION 41 – MATERIAL PROCESSING AND HANDLING EQUIPMENT

(None in this Work)

DIVISION 42 – PROCESS HEATING, COOLING, AND DRYING EQUIPMENT

(None in this Work)

DIVISION 43 – PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT

(None in this Work)

DIVISION 44 – POLLUTION AND WASTE CONTROL EQUIPMENT

(None in this Work)

DIVISION 45 – INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT

(None in this Work)

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

(None in this Work)

DIVISION 48 – ELECTRICAL POWER GENERATION

(None in this Work)

Appendix A: Owner-Furnished Asbestos-Containing Materials Survey and Assessment 1-16

Appendix B: Owner-Furnished Lead-Based Paint Survey and Assessment 1-16

END OF INDEX

**DEPARTMENT OF FINANCE AND ADMINISTRATION**
BUREAU OF BUILDING, GROUNDS AND
REAL PROPERTY MANAGEMENT
JACKSON, MISSISSIPPI

# ADVERTISEMENT FOR BIDS

Sealed bids will be received electronically via MAGIC or physically delivered to the office of the Bureau of Building, Grounds and Real Property Management, 501 North West Street, Suite 1401 B, Jackson, Mississippi, 39201, until 2:00:00 p.m. on Thursday, 01/27/2022 , for:

RE: GS# 354-050 Tenant Improvement-DMH (First, Second, Tenth, Eleventh, and Twelfth Floors )
Robert E. Lee Building (Office of Capitol Facilities) (Department of Finance and Administration)
RFx # 3160004776

at which time they will be publicly opened and read. Contract documents may be obtained from:

| | |
|---|---|
| Professional: | Burris/Wagnon Architects, P.A. |
| Address: | 500L East Woodrow Wilson Avenue |
| | Jackson, Mississippi 39216 |
| Phone: | 601-969-7543 |
| Email: | info@burriswagnon.com |

A deposit of $100.00 is required. Bid preparation will be in accordance with Instructions to Bidders bound in the project manual. The Bureau of Building, Grounds and Real Property Management reserves the right to waive irregularities and to reject any or all bids. **NOTE: Telephones and desks will not be available for bidders use at the bid site.**

Bureau of Building, Grounds and Real Property Management

**Dates of Publication:**

12/28/2021
01/04/2022

# INSTRUCTIONS TO BIDDERS
## SECTION 00 2100

### PART 1 - GENERAL

1.01 **QUESTIONS:** Questions should be directed to the Professional. Should a Bidder find discrepancies in, or omissions from, the procurement documents, or be in doubt as to their meaning, the Bidder should immediately notify the Professional. The Professional will send written instruction(s) or interpretation(s) to all known holders of the documents. Neither the Owner, nor the Professional, will be responsible for any oral instruction or interpretation.

1.02 **BIDDER'S QUALIFICATIONS:**

A. **Certificate of Responsibility:** The Mississippi State Board of Contractors is responsible for issuing Certificates of Responsibility to Contractors. To be awarded a Contract for public work, Sections 31-3-15 and 31-3-21 of the **Mississippi Code of 1972, Annotated** requires a Contractor to have a current Certificate of Responsibility at bid time and during the entire length of the job. The Certificate of Responsibility number issued becomes a significant item in all public bidding.

B. **Bid Under $50,000:** If a Bidder submits a bid not exceeding $50,000, no Certificate of Responsibility number is required; however, a notation stating the *bid does not exceed $50,000* shall appear on the face of the envelope, or a Certificate of Responsibility number.

C. **Bid Over $50,000:** Each Bidder submitting a bid in excess of $50,000 shall show its Certificate of Responsibility number on the bid and on the face of the envelope containing the bid.

D. **Joint Venture Bid:** When multiple Contractors submit a joint venture bid in excess of $50,000, a *joint venture* Certificate of Responsibility number shall be shown on the bid and on the face of the envelope containing the bid. If the Multiple-Contractor joint venture has no *joint venture* Certificate of Responsibility number, each of the Contractors participating in the bid shall indicate their individual Certificate of Responsibility numbers on the bid and on the face of the envelope.

1.03 **NON-RESIDENT BIDDER:** When a non-resident Bidder (a Contractor whose principal place of business is outside the State of Mississippi) submits a bid for a Mississippi public works project, one of the following is required and shall be submitted with the Proposal Form: (Code 31-3-21(3))

A. **Copy of Law:** If the non-resident Bidder's state has a resident Bidder preference law, a copy of that CURRENT law shall be submitted with the Proposal Form.

B. **Statement:** If the state has no such law then a statement indicating *the State of (Name of State) has no resident Contractor preference law* shall be submitted with the Proposal Form.

1.04 **DISQUALIFICATION OF BIDDER:** A Bidder may be disqualified for any of the following reasons:

A. Failure to comply with the bid requirements.

B. Bidder is in arrears on existing Contracts with the Bureau or another state agency, university, community college, or junior college.

C. Bidder is involved in an ongoing dispute related to the Bidder's execution, workmanship, or timely performance of a previous Contract with the Bureau or another state agency, university, community college, or junior college.

D. Bidder has defaulted on a previous Contract with the Bureau of another state agency, university, community college, or junior college.

1.05 **CONDITIONS OF WORK:** Each Bidder must fully inform himself of all conditions relating to the construction of the Project and employment of labor thereon. Failure to do so will not relieve a successful Bidder of obligations to furnish all material and labor necessary to carry out the provisions of the Contract. Insofar as possible, the Bidder must employ methods, or means, which will not cause interruption of, or interference with, the work of any other Bidder, or Contractor.

1.06 **EXAMINATION OF SITE:** All Bidders, including the general Contractor and Subcontractors, shall visit the building site, compare the Drawings and Project Manual with any work in place and be informed of all conditions. Failure to visit the site will in no way relieve the successful Bidder from furnishing any materials or performing any work required to complete work in accordance with Drawings and Project Manual without additional cost to the Owner.

1.07 **LAWS AND REGULATIONS:** The Bidder's attention is directed to the fact that all applicable Mississippi state laws, rules and regulations of all authorities having jurisdiction over construction of the Project apply to the Contract.

1.08 **OBLIGATION OF BIDDER:** At the bid opening, each Bidder will be presumed to have inspected the site, read and become thoroughly familiar with the Drawings and the Project Manual, including all addenda.

1.09 **BID DOCUMENT DEPOSIT AND RETURN:** The deposit amount, if any, shall be established as the estimated actual cost of copying and reproduction plus shipping via USPS standard Ground Transportation, is shall be indicated in the Advertisement for Bids. Bidders may request shipping via express carrier or expedited delivery at their own additional cost. Upon returning the documents to the Professional within ten (10) working days of the bid date and in good condition, all document holders will be refunded the full deposit amount. Further, any document holder who is awarded the contract, related subcontracts and/or vendor agreements may elect to retain their documents and request refund of the full deposit amount upon execution of the construction contract and approval of general contractor, however; such documents shall be counted toward the total number of copies furnished free of charge to the general contractor. No partial sets of documents will be issued. Selected trade organizations, plan rooms and web-based distribution networks will be issued one (1) set of documents without charge.

## PART 2 - PROPOSAL FORM

2.01 **METHOD OF BIDDING:** Lump sum, single bids received on a general contract will include general, mechanical and electrical construction and all work shown on Drawings or specified in the Project Manual.

2.02 **PROPOSAL FORMS:** The Bidder shall make all proposals on forms provided and shall fill all applicable blank spaces without interlineations or alteration and must not contain recapitulation of the work to be done. No oral or telegraphic proposals will be considered.

2.03 **TIME OF COMPLETION:** The Bidder shall agree to commence work on, or before, a date specified in a written *Notice to Proceed* and fully complete the Project within the calendar days indicated on the Proposal Form.

2.04 **BASE BID AND ALTERNATES:**

A. On the Proposal Form, the Bidder shall write out the Base Bid amount in words and include the numerical amount The written word shall govern.

B. The Proposal Form shall contain a brief description of each alternate modifying the scope. The Bidder shall write out the amount in words and include the numerical amount for each alternate. The written word shall govern.

2.05 **SUBSTITUTIONS:** No substitutions, qualifications or redefining of the Specification requirements are allowed to be marked on the Proposal Form, unless specifically required by the Bid Documents.

2.06 **ADDENDA:** Any addenda to the Drawings or Project Manual issued before or during the time of bidding shall be included in the proposal and become a part of the Contract. The Proposal Form will have ample space to indicate the receipt of addenda. When completing the Proposal Form, the Bidder shall list the Addendum number in spaces provided.

2.07 **BIDDER IDENTIFICATION:**

A. **Signature:** The Proposal Form shall be signed by any individual authorized to enter into a binding agreement for the Business making the bid proposal.

B. **Name of Business:** The name appearing on the Proposal Form should be the complete spelling of bidder's name exactly as recorded at the Secretary of State, which should also be the same as at the Mississippi State Board of Contractors.

C. **Legal Address:** The address appearing on the Proposal Form should be the same address as recorded at the Secretary of State, which should also be the same as at the Mississippi State Board of Contractors.

D. **Certificate of Responsibility Number(s):** The Certificate of Responsibility Number(s) appearing on the Proposal Form should be the same number appearing in the current Mississippi State Board of Contractors Roster.

2.08 **BID SECURITY:** The Bid Security shall be in the form of a Bid Bond, or a Certified Check:

A. **Bid Bond:** The Bidder may submit a Bid Bond by a Surety licensed in Mississippi in the amount of five percent (5%) of the base bid. The Bid Bond shall be duly executed by the Bidder, a Mississippi Licensed Agent for said Surety approved by the Mississippi Insurance Department OR signed by the Surety AND countersigned by a Mississippi

Licensed Agent for said Surety approved by the Mississippi Insurance Department https://www.mid.ms.gov (or most up-to-date link) (No standard form is required for the Bid Bond.) Where bid is to be submitted electronically, a scanned copy of bid bond is acceptable.

B. **Certified Check:** The Bidder may submit a certified check made out to the *Bureau of Building, Grounds and Real Property Management* in the amount of five percent (5%) of the base bid. All checks received from Bidders will be returned upon request, unless a Bidder is one (1) of the three (3) apparent low Bidders. The three (3) apparent low Bidder's checks will be held for forty-five (45) days, unless a Contract is awarded and executed in less time. Where bid is to be submitted electronically, certified check must be physically delivered to the address indicated on the Advertisement for Bids prior to the time and date stated.

2.09 **POWER OF ATTORNEY:** Each bid security must be accompanied by an appropriate Power of Attorney. No Power of Attorney is necessary with a certified check.

## PART 3 - SUBMITTING THE PROPOSAL FORM

3.01 **SUBMITTAL:** A bid must be either submitted electronically via MAGIC or physically delivered to the address indicated on the Advertisement for Bids prior to the time and date stated.

A. **Physical Submittal:** If physically submitted, only one original of Bid Proposal shall be submitted which should be sealed in an opaque envelope marked, mailed or hand-delivered as shown below. If the Bid is mailed, the bid envelope shall be placed inside a second envelope to prevent inadvertent premature opening of the Proposal.

*(In upper left hand corner)*
**Name of Firm** (complete spelling of bidder's name and address – exact as recorded at the Secretary of State which should be the same as you applied for at the Mississippi State Board of Contractors)

*(Bid shall be addressed and delivered to)*
Bureau of Building, Grounds and Real Property Management
501 North West Street, Suite 1401B [Woolfolk Building]
Jackson, Mississippi 39201

*(In lower left hand corner)*
Bid for Project # _____
Title _____
Using Agency _____
Certificate of Responsibility # _____(for over $50,000.00)
Under $50,000.00 (add statement)

B. **Electronic Submittal:** Bidders must be registered prior to submitting bids electronically. It is the responsibility of the Bidder to allow sufficient time to complete or confirm such registration before the date and time established to receive bids. Information on registration and bidding electronically may be found at www.dfa.ms.gov/dfa-offices/mmrs/mississippi-suplliers-vendors. For further assistance e-mail mash@dfa.ms.gov OR call (601) 359-1343, Option 2. If a Bidder desires to receive system generated Construction Bid Notices for future Bureau of Building, Grounds and Real Property Management opportunities, use Product Code 90922.

3.02 **MODIFICATION TO BID:** A bidder may only modify the bid prior to the scheduled closing time indicated in the Advertisement for Bids in the following manner:

A. **Physical Bid:** A modification may be written on the outside of the sealed envelope containing the bid.
B. **Electronic Bid:** Information and attachments may be modified and re-submitted via MAGIC.

3.03 **WITHDRAWAL OF BID:** Any bid may be withdrawn prior to the scheduled time for opening of bids. However, after the scheduled opening, bids may not be withdrawn until forty-five (45) calendar days after bid opening.

## PART 4 - BID OPENING AND AWARD OF CONTRACT

4.01 **OPENING OF BIDS:** Bids will be publicly opened shortly after the time stated in the Advertisement for Bids. Bidder representatives are invited; however, attendance is not mandatory. Closure of agency preventing the opening of bids at the advertised date and time due to Force Majeure Event reasons will result in bids being publicly opened on the next business day that the agency shall be open and at the previously advertised time. Physical Bids without a Certificate of Responsibility on the outside of the envelope, or a statement indicating bid is under $50,000.00, will not be opened. Electronic Bids where Certificate of Responsibility or statement indicating bid is under $50,000.00 is not entered as response to required question will, not be considered.

4.02 **IRREGULARITIES:** The omission of any information requested on the Proposal Form may be considered as an informality, or irregularity, by the awarding public body when in their opinion the omitted information does not alter the amounts contained in the submitted bid proposal, or place other Bidders at a disadvantage.

4.03 **PROTEST:** Any protest must be delivered in writing to the Owner within twenty-four (24) hours after the bid opening.

4.04 **ERRORS:** Any claim of error and request for release from bid must be delivered in writing to the Owner within twenty-four (24) hours after the bid opening. The Bidder shall subsequently and promptly provide sufficient documentation with the written request clearly proving an error was made. Failure to provide such documentation adequate to prove an error may result in forfeiture of Bid Security to the Owner.

4.05 **AWARD OF CONTRACT:** The Owner reserves the right to reject any or all bids. A Contract will be awarded (subject to receipt of an executable contract) on the basis of the lowest, responsive, responsible base bid, or lowest combination of base bid and those alternates selected by the Owner generally in the order listed unless a different order is determined to be in the best interest of the Using Agency and/or Owner and which produces a total within available funds. Where such bidder fails to enter into a contract, the Owner reserves the right to award to the next lowest responsive, responsible bidder or resolicit the project.

4.06 **FAILURE TO ENTER INTO A CONTRACT:** The Bidder shall forfeit the Bid Security to the Owner as liquidated damages for any of the following reasons:

A. Prior to award, failure, or refusal, to furnish the names, classifications and COR #s of Sub-Contractors over Fifty Thousand Dollars ($50,000.00) as well as entities who are to furnish materials or equipment fabricated to a special design within three (3) working days after receipt of Notice of Intent to Award the Contract.

B. Prior to award, failure, or refusal, to furnish substitute acceptable Sub-Contractors or entities within five (5) working days of when the Owner or Prime Professional has made reasonable objection to those initially submitted.

C. Following Notice of Award (subject to executable contract), failure, or refusal, to execute and deliver the Form of Agreement Between the Owner and the Contractor, the Performance and Payment Bond, and the Certificate of Insurance within ten (10) working days after receipt of same from the Professional.

4.07 **SECURITY FOR FAITHFUL PERFORMANCE:** Simultaneously, with delivery of the executed Contract, the Contractor will furnish a Surety Bond, or Bonds, as security for faithful performance, the payment of all persons performing labor on the project, and furnishing materials in connection with this Contract. The Surety on such Bond, or Bonds, will be a duly authorized surety company satisfactory to the Owner and meeting all of the following requirements:

A. Licensed at the time of award by the State of Mississippi's Commissioner of Insurance for the purpose of providing surety. https://www.mid.ms.gov (or most up-to-date link)

B. Listed at the time of award in the Department of the Treasury's **Federal Register** as a company holding certificates of authority as acceptable sureties on Federal Bonds, commonly referred to as the Treasury List.

C. All Bonds shall be executed on the form provided in the Project Manual under Section 00 6100 entitled *Contract Bond*.

D. The Contract Bond shall be duly executed by the Bidder, a Surety licensed in Mississippi signed by a Mississippi Licensed Agent for said Surety approved by the Mississippi Insurance Department OR signed by the Surety AND countersigned by a Mississippi Licensed Agent for said Surety approved by the Mississippi Insurance Department with the name and address typed (or lettered legibly), and Surety Seal (preferably embossed). https://www.mid.ms.gov (or most up-to-date link)

E. All Bonds must be accompanied by an appropriate Power of Attorney dated same as Contract Bond and sealed (preferably embossed ~~seal~~).

## PART 5 - BIDDER'S CHECKLIST

The following checklist is for the Bidder's assistance only. It is not inclusive and does not have to be included with the Proposal Form when submitting a bid proposal.

5.01 **PROPOSAL FORM**: (only one original proposal form to be submitted)

**Base Bid**

( ) Write in the amount of the base bid in words and numbers. In the case of a conflict, the written word shall govern.

**Alternates**

( ) Write in each alternates amount in words and numbers. In the case of a conflict, the written word shall govern.

**Addenda**

( ) Acknowledge the receipt of each addendum by writing in the number of the addendum.

**Acceptance**

( ) Proposal is signed by authorized person

( ) Name of Business - complete spelling of bidder's name and address - exact as recorded at the Secretary of State [http://www.sos.state.ms.us/busserv/corp/soskb/csearch.asp ] which should be the same as you applied for at the Mississippi State Board of Contractors [http://www.msboc.us/Search2.CFM ]

( ) Legal address of the business listed above (at SOS and Contractor's Board)

( ) Correct Certificate of Responsibility Number(s) as it appears in the current MS State Board of Contractors Roster

**Certificate of Responsibility Number(s)**

( ) Base Bid is under $50,000 and no number is required AND the statement "bid does not exceed $50,000" is on the outside of the sealed envelope or statement included with electronic bid

**OR** ( ) Base Bid is $50,000 or more and number is required and is on the outside of the sealed envelope or included with electronic bid

( ) Joint Venture and *joint venture* number is required

**OR** ( ) Joint Venture participants' numbers are required

5.02 **BID SECURITY:**

( ) Included Bid Bond

**OR** ( ) Included Certified Check

5.03 **POWER OF ATTORNEY:**

( ) Included Power of Attorney

5.04 **NON-RESIDENT BIDDER:**

( ) Attached a Copy of Non-Resident Bidder's Preference Law

**OR** ( ) Attached a Statement

5.05 **SUB-CONTRACTORS NAME:**

( ) List any Mechanical, Plumbing, and/or Electrical Sub-Contractors regardless of cost.

* List name even for under $50,000 (see 5.06 regarding COR)
* Fire Protection Sprinkler Contractors do not have to be listed
* If there is a separate HVAC/Plumbing Sub-Contractor, so notate as mentioned herein
* If Mechanical, Plumbing, and/or Electrical Sub-Contractor is performed by the General, be sure the General has a COR for said discipline
* If there is no Mechanical, Plumbing, and/or Electrical Sub-Contractor listed, then use of Sub-Contractor to perform such scope will not be permitted.

5.06 **SUB-CONTRACTORS' COR NUMBER**

( ) * List Certificate of Responsibility Number for any listed Sub-Contractor over $50,000.00

***** END OF SECTION *****

## Division 0

# PROPOSAL FORM
## SECTION 00 4200

To: Bureau of Building, Grounds and Real Property Management
501 North West Street, Suite 1401B [Woolfolk Building]
Jackson, Mississippi 39201

Re: Project # 354-050 (PP003)
Project Title Tenant Improvements (DMH) (First, Second, Tenth, Eleventh, and Twelfth Floors)
Location Robert E. Lee Building, Jackson, Mississippi

I propose to complete all work in accordance with the Project Manual and Drawings within 365 consecutive calendar days for the sum of: (Professional must specify number of days)

**BASE BID:** **(**Write in the amount of the base bid in words and numbers. In case of conflict, the written word governs.)

Words: _____ Dollars
Figures: ($_____)

**ALTERNATES:** **(**Write in the amount of all of the alternates in words and numbers. In case of conflict, the written word governs.)

**Alternate #1** ☐ Adds ☐ Deducts
Words: _____Dollars
($_____)
Description: Exterior masonry repair at the second, third and twelfth floors as described on Sheets 8.0 and 9.0 of the Drawings.

**Alternate #2** ☐ Adds ☐ Deducts
Words: _____Dollars
($_____)
Description: _____

**Alternate #3** ☐ Adds ☐ Deducts
Words: _____Dollars
($_____)
Description: _____

**Alternate #4** ☐ Adds ☐ Deducts
Words: _____Dollars
($_____)
Description: _____

**Alternate #5** ☐ Adds ☐ Deducts
Words: _____Dollars
($_____)
Description: _____

BID UNIT PRICES: (Refer to Drawings, Sheet "TS")

Unit Price #1 (Plaster Repair).....$_____ per sf of wall area
Unit Price #2 (Wood Base).....$_____ per lf of wood base
Unit Price #3 (Gypsum Board)....a. $_____ per sf of 5/8" mold-resist. gyp. bd. on 7/8" hat chan. or 1/2" resil. chan.
b. $_____ per sf of 5/8" mold-resist. gyp. bd. one side 3-5/8" mtl. studs
c. $_____ per sf of 5/8" mold-resist. gyp. bd. ea. side 3-5/8" mtl. studs
d. $ _____ per sf of 5/8" type x gyp. bd. (1 layer) laminated directly to any wall surface
e. $_____ per sf of 5/8" suspended gyp. bd. ceiling (metal framing per specs)

**ADDENDA ACKNOWLEDGMENT:**

No. _____ No. _____ No. _____

No. _____ No. _____ No. _____

**ACCEPTANCE:**

I certify that I am authorized to enter into a binding contract, if this Proposal is accepted.

Signature _____ Date _____

Name and Title_____

Name of Business _____

Address _____(mailing)

Address _____(physical)

City/State/Zip Code _____County _____

Phone _____ Fax _____ Email _____

■ **BIDDER'S CERTIFICATE OF RESPONSIBILITY NUMBER:** _____

■ **MINORITY BUSINESS ENTERPRISE? Yes _____ No _____** (to assist with Code 57-1-57)

■ Attach copy of Non-Resident Bidder's Preference Law

## ■ Mechanical / Plumbing / Electrical Contractors:

Regarding said Divisions of the Specifications of the BoB Standard Form of Agreement Between The Owner and The Contractor:

List any Mechanical/Plumbing and/or Electrical Sub-Contractors that will perform work of this contract, regardless of cost even for under $50,000.00. COR must be included where sub-contract exceeds $50,000.00. If no sub-contractor is listed, and such work is within scope of contract and over $50,000.00, bidder's own COR classification(s) must be sufficient to self-perform any such work. If no sub-contractor is listed, then use of sub-contractor to perform such scope will not be permitted.

Mechanical Contractor: _____ Certificate of Responsibility No. _____
Plumbing Contractor: _____ Certificate of Responsibility No. _____
Electrical Contractor: _____ Certificate of Responsibility No. _____

# STANDARD FORM OF AGREEMENT BETWEEN THE OWNER AND THE CONTRACTOR
## SECTION 00 5200

This Agreement made the _____ day of _____, 20_____ between the Owner,

Bureau of Building, Grounds and Real Property Management
501 North West Street, Suite 1401B [Woolfolk Building]
Jackson, Mississippi 39201

created by Section 7-1-451 et seq., and Section 31-11-1, et seq., **Mississippi Code of 1972, Annotated**, and acting for the State of Mississippi;

and between the Contractor:

Business Name _____
Address _____
City/State/Zip _____ Phone: _____Fax:_____Email:_____

The Contractor is a (check and complete one of the following):

_____ ☐ CORPORATION or ☐ LLC solely organized and existing under the laws of the State of _____ and having its principal office in _____, _____, _____
(City) (County) (State

_____ PARTNERSHIP of the following (list all partners):
_____
_____
_____

_____ SOLE PROPRIETORSHIP

For the following Project: GS# 354-050 (GC003)
Tenant Improvements (DMH)
Robert E. Lee Building (First, Second, Tenth, Eleventh, and Twelfth Floors)
(Office of Capitol Facilities)
(Department of Finance and Administration)
Jackson, Mississippi

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

OWNER: BUREAU OF BUILDING, GROUNDS AND REAL PROPERTY MANAGEMENT

By:_____
(Signature)

_____
(Name and Title)

CONTRACTOR:

By:_____
(Signature)

_____
(Name and Title)

APPROVED AS TO FORM:

By: _____
(Signature of Attorney)

THE OWNER AND THE CONTRACTOR AGREE AS SET FORTH IN PAGES ONE THROUGH THREE, ARTICLES ONE THROUGH FIVE, AS FOLLOWS:

**ARTICLE 1: THE WORK AND CONTRACT DOCUMENTS**

1.1.1 The Contractor will perform all the work required by the Contract Documents for the Project indicated above.

1.2 **THE CONTRACT DOCUMENTS**

1.2.1 The Contract Documents which constitute the entire Agreement between the Owner and the Contractor, are enumerated as follows:

1.2.2 Project Manual dated 14 September 2021

BIDDING REQUIREMENTS
- Advertisement for Bids
- Instructions to Bidders
- Proposal Form

STANDARD FORM OF AGREEMENT BETWEEN THE OWNER AND THE CONTRACTOR
CONTRACT BOND
POWER OF ATTORNEY
CERTIFICATE OF INSURANCE
AFFIDAVIT OF PAYMENT TO ALL SUBCONTRACTORS
CONDITIONS OF THE CONTRACT
- General Conditions
- Supplementary Conditions
- Labor Requirements
- Minority Participation
- Special Conditions

ADDENDA
SPECIFICATIONS (check the specs listed on the contents and included in the manual)

- [X] Division 1: General Requirements
- [X] Division 2: Existing Conditions
- [ ] Division 3: Concrete
- [X] Division 4: Masonry
- [X] Division 5: Metals
- [X] Division 6: Wood, Plastics and Composites
- [X] Division 7: Thermal and Moisture Protection
- [X] Division 8: Openings
- [X] Division 9: Finishes
- [X] Division 10: Specialties
- [X] Division 11: Equipment
- [ ] Division 12: Furnishings
- [ ] Division 13: Special Construction
- [ ] Division 14: Conveying Equipment
- [X] Division 21: Fire Suppression
- [X] Division 22: Plumbing
- [X] Division 23: HVAC
- [ ] Division 25: Integrated Automation
- [X] Division 26: Electrical
- [ ] Division 27: Communications
- [X] Division 28: Electronic Safety and Security
- [ ] Division 31: Earthwork
- [ ] Division 32: Exterior Improvements
- [ ] Division 33: Utilities
- [ ] Division 34: Transportation
- [ ] Division 35: Waterway and Marine Construction
- [ ] Division 40: Process Interconnections
- [ ] Division 41: Material Processing and Handling Equipment
- [ ] Division 42: Process Heating, Cooling, and Drying Equipment
- [ ] Division 43: Process Gas and Liquid Handling, Purification, and Storage Equipment
- [ ] Division 44: Pollution and Waste Control Equipment
- [ ] Division 45: Industry-Specific Manufacturing Equipment
- Division 46: Water and Wastewater Equipment
- [ ] Division 48: Electrical Power Generation

1.2.3 Addenda

Addendum No. 1, dated _____
Addendum No. 2, dated _____
Addendum No. 3, dated _____
Addendum No. 4, dated _____
Addendum No. 5, dated _____

1.2.4 Drawings dated 14 September 2021

Sheets No. TS through _____
Sheets No. 2.0 through 2.3
Sheets No. 3.0 through _____
Sheets No. 4.0 through _____
Sheets No. 5.0 through _____
Sheets No. 6.0 through _____
Sheets No. 7.0 through _____
Sheets No. 8.0 through _____
Sheets No. 9.0 through _____
Sheets No. M0.1 through _____
Sheets No. MD1.0 through MD1.1
Sheets No. MD2.1 through MD2.3
Sheets No. M1.0 through M1.3
Sheets No. M2.1 through M2.2
Sheets No. M5.1 through _____
Sheets No. M6.1 through M6.3
Sheets No. E100 through _____
Sheets No. E200 through _____
Sheets No. E300 through E302

1.2.5.1 Other documents, dated E400-402, E500-502, E600, E700, E800, AV100, AV101, AV200, AV201

## ARTICLE 2: CONTRACT SUM

2.1 **CONTRACT SUM**

2.1.1 The Owner will pay the Contractor in current funds for the performance of the work subject to additions and deductions by Change Order as provided in the Contract Documents, the Contract Sum of

_____Dollars

($ _____). The Contract sum is determined as follows:

| | | |
|---|---|---|
| Base Bid | | $_____ |
| Modifications | ( ) Adds ( ) Deducts | $_____ |
| Negotiations | | $_____ |
| Alternate No. _____ | ( ) Adds ( ) Deducts | $_____ |
| Alternate No. _____ | ( ) Adds ( ) Deducts | $_____ |
| Alternate No. _____ | ( ) Adds ( ) Deducts | $_____ |
| Alternate No. _____ | ( ) Adds ( ) Deducts | $_____ |
| Alternate No. _____ | ( ) Adds ( ) Deducts | $_____ |
| **Total Contract Sum** | | $_____ |

2.2 **LIQUIDATED DAMAGES**

2.2.1 The stipulated liquidated damages described in Paragraph 9.11 of the *Supplementary Conditions* are in the amount of Three Hundred Dollars ($ 300.00 ) for each calendar day.

## ARTICLE 3: CONTRACT TIME

3.1 **TIME**

3.1.1 The work to be performed under this Contract shall be commenced upon the date stated in the *Notice to Proceed.* The work is to be substantially complete, subject to approved Change Orders, no later than 365 calendar days from the date stated in the *Notice to Proceed*.

## ARTICLE 4: PAYMENTS AND FINAL PAYMENTS

4.1 **PROGRESS PAYMENTS**

4.1.1 Based upon applications for payment submitted to the Professional by the Contractor and *Certificates for Payment* issued by the Professional, the Owner will make progress payments on account of the Contract Sum to the Contractor as provided in the Contract Documents.

4.2 **FINAL PAYMENT**

4.2.1 Final payment constituting the entire balance of the Contract Sum will be paid by the Owner to the Contractor when the work has been completed, the Contract fully performed and a final Certificate for Payment has been issued by the Professional and approved by the Owner.

## ARTICLE 5: MISCELLANEOUS PROVISIONS

5.1 **DEFINITION OF TERMS**

5.1.1 Terms used in this Agreement which are defined in the General, Supplementary, and Special Conditions of the Contract will have the meanings designated in those Conditions.

5.2 **CONTRACTOR'S INTEREST IN AGREEMENT**

5.2.1 The Contractor will not assign, sublet, or transfer the interest in this Contract agreement without the written consent of the Owner. The Owner and Contractor hereby agree to the full performance of the covenants contained herein.

5.3 **PROFESSIONAL**

5.3.1 The Professional assigned to this Project is as follows:

Name Burris/Wagnon Architects, P.A.
Address 500L E Woodrow Wilson Avenue
Telephone (601)969-7543 Fax Number _____ E-Mail Address info@burriswagnon.com

***** END OF SECTION *****

# CONTRACT BOND
## SECTION 00 6100

### I. PREAMBLE

KNOW ALL MEN BY THESE PRESENTS: THAT _____,
Principal, a _____, residing at _____, authorized to do business in the State of Mississippi under the laws thereof, and _____Surety, a corporation of the State of _____, authorized to do business in the State of Mississippi under the laws thereof, are held and firmly bound unto the Bureau of Building, Grounds and Real Property Management of the State of Mississippi, Obligee, hereinafter referred to as "Owner," for the use and benefit of the Owner and those claimants and others set forth herein below and described in Sections 31-5-51 and 31-5-3, **Mississippi Code of 1972, Annotated**, as amended, in the amount of _____ _____ Dollars ($_____), lawful money of the United States, for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these present.

WHEREAS, Principal has by written agreement dated _____, 20_____, entered into a Contract with the Owner for the following:

_____
_____
_____

as provided in said Contract and in accordance with the Contract Documents. All of the terms and provisions of the above mentioned Contract, drawings, Project Manual, and addenda are by reference made a part hereof and fully incorporated herein, and are hereinafter referred to as "the Contract." All of the terms and provisions of Sections 31-5-51, 31-5-3, supra, Section 31-5-53 of the **Mississippi Code of 1972, Annotated**, as amended, and all other code sections cited herein are also by reference made a part hereof and fully incorporated herein.

### II. PERFORMANCE BOND

NOW, THEREFORE, the condition of this Performance Bond is such that if Principal shall promptly and faithfully perform said Contract, then this obligation shall be null and void; otherwise, it shall remain in full force and effect, subject however, to the following conditions:

Whenever the Owner has performed its obligation but the Principal has defaulted under the terms of the Contract, or any portion thereof, and the Owner has declared the Principal to be in default, the Surety shall promptly:

1. Remedy the default, or
2. Complete the Contract in accordance with its terms and conditions, or
3. Procure the completion of the Contract in accordance with its terms and conditions.

Even if there should be a succession of defaults, the Surety is responsible for completion of the Contract. The Surety shall provide sufficient funds to pay the cost of completion of the Contract in its entirety including other costs and damages for which the Surety may be liable thereunder, less the balance of the Contract price. The term "balance of the Contract price," as used in this paragraph, shall mean the total amount payable by Owner to Principal under the Contract and any Change Orders thereto, less the amount paid by Owner to Principal.

### III. LABOR AND MATERIAL PAYMENT BOND

NOW, THEREFORE, the condition of this Labor and Material Payment Bond is such that if Principal shall promptly make payments to all persons supplying labor or material used in the prosecution of the work under said Contract, then this obligation shall be null and void; otherwise, it shall remain in full force and effect; however, the Owner shall not be liable for the payment of any costs or expenses of any suit described in Subsection (2) of Section 31-5-51, supra.

## IV. BOND FOR PAYMENT OF TAXES AND OTHER ASSESSMENTS

NOW THEREFORE, the condition of this Bond for Payment of Taxes and Other Assessments is such that if Principal shall promptly make payment of all taxes, licenses, assignments, contributions, damages, penalties, and interest thereon, when and as the same may lawfully be due the State of Mississippi, or any County, Municipality, Board, Department, Commission, or political subdivision thereof, by reason of and directly connected with the performance of said Contract or any part thereof as provided by Sections 27-65-1, 27-65-21, 27-67-1, and 31-5-3, **Mississippi Code 1972, Annotated**, or any other applicable statute or other authority, then this obligation shall be null and void; otherwise, it shall remain in full force and effect.

## V. GENERAL CONDITIONS

The following conditions apply to all three (3) of the above-mentioned Bonds:

1. The Performance Bond is for an amount equal to the full amount of said Contract.
2. The Labor and Material Payment Bond is for an amount equal to the full amount of said Contract.
3. If any changes are made in the work, or any extensions of time are granted, or any increases in the total dollar amount of the Contract are made, such changes, extensions, increases, or other forbearance on the part of either the Owner or the Principal will not, in any way, release the Principal and Surety, or either of them, from their liability hereunder, or any portion thereof, notice to the Surety of any such change, extension, increase, or forbearance being expressly waived.
4. These Bonds are governed by and shall be construed in accordance with Mississippi law. Any inconsistency with these Bonds and any provision of Mississippi law shall be remedied by deleting the inconsistent portion of these Bonds and leaving the remaining consistent portions in full force and effect.

Signed and sealed this _____ day of _____, 20_____.

SURETY _____
Mississippi NAIC number: _____

By: _____
(Signature)

_____ Attorney-in-Fact
(Typed Name) (Title)

Surety Agent MS Ins Dept License Number: _____
(Leave blank if you do not have a Mississippi #)

_____
(Surety Address)

_____
(Surety City/State/Zip/Phone)

_____
(MS LICENSED AGENT COMPANY NAME)
(add MS Agent's address below)

COUNTERSIGNED: (if Surety Agent above is NOT MS Licensed)

_____
(Signature)

_____ Licensed Mississippi Agent
(Typed Name) (Title)

Countersignature Agent MS License Number: _____

_____
(MS Licensed Agent Address)

_____
(MS Licensed Agent City/State/Zip/Phone)

PRINCIPAL _____

By: _____
(Signature) (same person on Bond and Contract page)

_____
(Typed Name and Title)

_____
(Address)

_____
(City/State/Zip/Phone)

Surety Company, Surety Agent's Name, Address, etc. should be typed and with seal (preferably embossed seal) on Bond and P/A. The P/A should be for the Attorney-in-Fact with seal (preferably embossed seal).

The Contract Bond shall be duly executed by the Bidder AND a MS Licensed Agent said Surety approved by the MS Ins Dept
OR
signed by the Surety's Agent AND countersigned by a MS Licensed Agent for said Surety approved by the MS Ins Dept.

Countersignature, when signed, can be the same as the Attorney-in-Fact when the Attorney-in-Fact and/or Surety IS licensed in Mississippi. Countersignature will be different when the Attorney-in-Fact and/or Surety is "not" licensed in Mississippi. P/A will be for the Attorney-in-Fact.

Check the Surety Company AND the Surety Agent
AND/OR the Countersignature Company and/or Agent at MS Ins Dept web:
https://www.mid.ms.gov (or most up-to-date link)

Easier to locate Agent at MID when name agrees with MID licensed name.)

(Bond Agent MID or Code requirements are different from the Ins Cert Agent MID or Code requirements.)

# CERTIFICATE OF INSURANCE
## SECTION 00 6216

This certificate of insurance neither affirmatively nor negatively amends, extends, or alters the coverage afforded by the policies below.

| | | |
|---|---|---|
| **INSURED**: (Contractor's Name & Address) | | **COMPANIES PROVIDING COVERAGE w/ MID Lic or NAIC #** |
| | **A** | # |
| | **B** | # |
| **PROJECT: (**Number, Name & Location) | **C** | # |
| | **D** | # |
| | **E** | # |
| **OWNER:** Bureau of Building, Grounds & Real Property Management | **F** | # |
| | **G** | # |
| | Companies above must be approved by the MS Ins Dept at https://www.mid.ms.gov (or most up-to-date link) per Code & WComp at http://www.mwcc.ms.gov/ (MID mod'd 041615) | |

| Type Insurance | Co | Policy Number | Policy Period | Coverage and Minimum Amount | |
|---|---|---|---|---|---|
| General Liability<br>Commercial<br>General Liability | | | | General Aggregate | $ 1,000,000 |
| | | | | Products Comp/Ops (Aggregate | $ 1,000.000 |
| | | | | Personal Injury (Per Occurrence) | $ 500,000 |
| | | | | BI & PD (Per Occurrence) | $ 1,000,000 |
| | | | | Fire Damage (Per Fire) | $ 50,000 |
| | | | | Medical Expense (Per Person) | $ 5,000 |
| Owners/Contractors Protective Liability | | | | General Aggregate | $ 1,000,000 |
| | | | | Per Occurrence | $ 500,000 |
| Automobile Liability | | | | Bodily Injury/Property Damage Combined Single Limit (Per Occurrence) | $ 500,000 |
| | | | | **OR** Bodily Injury (Per Person) | $ 250,000 |
| | | | | Bodily Injury (Per Accident) | $ 500,000 |
| | | | | Property Damage (Per Occurrence) | $ 100,000 |
| * Excess Liability (Umbrella on projects over $500,000) | | | | Aggregate | $ 1,000,000 |
| | | | | Per Occurrence | $ 1,000,000 |
| Workers' Compensation (As required by Statute)<br>Employers' Liability | | | | Accident (Per Occurrence) | $ 100,000 |
| | | | | Disease-Policy Limit | $ 500,000 |
| | | | | Disease-Per Employee | $ 100,000 |
| Property Insurance (not required when project is demolition ONLY – required for ALL other projects including paving) | | | | **OR** Builders' Risk<br>Installation Floater | Must be equal to Value of Work |
| Other | | | | | |

Certification: I certify that these policies (subject to their terms, conditions and exclusions) have been (1) issued to the Insured for the coverages and at least the amounts as indicated by companies licensed in Mississippi; (2) countersigned by a Mississippi Licensed Agent; and (3) endorsed to require the company to give thirty (30) days written notice to the Owner prior to cancellation or non-renewal of above.

| | |
|---|---|
| **Producing Agent:** (Name, Address and Telephone) | (Signature) MID Lic # or countersign below |
| | (Name and Title of Authorized Representative) (typed) |
| | Agent must be approved by the MS Ins Dept or countersign https://www.mid.ms.gov |

☐ Check if Mississippi Licensed Agent
OR Countersign by Mississippi Licensed Agent _____ MID Lic # _____

# CERTIFICATE OF INSURANCE INSTRUCTIONS
## SECTION 00 6217

1. The *Certificate of Insurance* is a tabulation of insurance required for this Project as specified in Article 11 entitled *Insurance and Bonds* in the General Conditions (AIA Document A201, Sixteenth Edition, 2017).

2. The *Certificate of Insurance* must be completed, certified by the original signature of a Mississippi Licensed Insurance Agent and/or countersignature, dated, and bound in each set of the Contract Documents. Insurance Companies providing coverage and Agent and/or Countersignature Agent must be approved by the Mississippi Insurance Department on their web at https://www.mid.ms.gov (or most up-to-date link). (Agent does not have to be on the MID web "for providers necessarily" – but must be an approved Agent on MID web. Easier to locate Agent at MID when name agrees with MID licensed name.)

3. Indicate Insured, Project, Companies providing coverage, policy numbers and policy periods in the blanks as applicable.

4. If the "OWNERS/CONTRACTORS PROTECTIVE LIABILITY" insurance is part of the Commercial General Liability Insurance Policy, or included by endorsement, indicate the policy number and period of the CGL policy in the "OWNERS/CONTRACTORS PROTECTIVE LIABILITY" blank spaces.

5. Automobile Liability Insurance may be provided which covers Bodily Injury and Property Damage in one (1) Combined Single Limit, or may be provided with separate minimum limits as shown on the Certificate of Insurance and specified in Article 11 of the Supplementary Conditions. The person signing the Certificate of Insurance should show which option the Contractor has selected by marking out the coverage that is not provided under the policies indicated.

6. OTHER INSURANCE (if required) will be indicated by typing in the "OTHER" block and detailed in Article 11 of the Supplementary Conditions.

7. CERTIFICATION wording may not be changed without specific written approval from the Owner (nor on any Owner documents even beyond Insurance Certificate).

8. "Riders", Binders, TBA, TBD, or other unsolicited attachments, are not allowed as part of the *Certificate of Insurance* unless specifically requested in writing by the Owner, or specified as part of the requirements for this Project (nor on any Owner documents even beyond Insurance Certificate).

9. CAUTION: The *Certificate of Insurance* is intended to be used for all Projects. The Contractor must provide all insurance specified in the Contract Documents for this Project, whether indicated on this form, or not. The Contractor must verify all insurance has been provided as required.

10. In accepting the Insurance Certificate by Owner, it would be helpful if some indication is given when, and if, the Provider is a Surplus Line Carrier, a Broker, or Self Insured (because they may not be on the MID web list referenced herein). (The Owner will have to ask MID (or know) at some point.)

11. The Workers Comp insurance provider must be approved and show up on the Workers Comp web at http://www.mwcc.state.ms.us / Services / Proof of Coverage Inquiry / accept / etc. and at the last step – enter the "contractor's name".

Note: Regarding #2 and #11. At the MID web – you enter the Surety Company / Provider / Agent. At the MWCC web – You enter the Vendor's name, then click on the policy number to see the MWCC Ins Provider.

***** END OF SECTION *****

**Division 0**

# AFFIDAVIT CERTIFYING PAYMENT TO ALL SUBCONTRACTORS

## SECTION 00 6300

Department of Finance and Administration
Bureau of Building, Grounds and Real Property Management

I acknowledge that, pursuant to Miss. Code Ann. §31-5-25 and H.B. 1562, Laws of 2002, that I am required to submit monthly certification indicating payments to subcontractors on prior payment requests. I, the undersigned Contractor, do hereby certify that I have paid the following amounts to subcontractors for Work which has been performed and incorporated into previous Applications for Payment which were issued and payment received from the Owner on the project listed below. I understand that this document must be submitted on a monthly basis after the submittal, approval and payment of Application for Payment #1. I understand that the Bureau of Building reserves the right to require me, the undersigned, to provide verification of payment and/ or additional information.

Project Number: _____

Project Name: _____

Using Agency: _____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

Subcontractor: _____ Amount: $_____

(Attach additional list of subcontractors and amounts, if necessary)

Contractor Name and Title: _____

Contractor Certificate of Responsibility Number: _____

Contractor Signature: _____ Date: _____

STATE OF MISSISSIPPI

COUNTY OF _____

SWORN TO AND SUBSCRIBED BEFORE ME, the undersigned notary public,

this the _____ day of _____, 20____.

_____
NOTARY PUBLIC

My Commission Expires:

_____

# GENERAL CONDITIONS
## SECTION 00 7200

### PART 1 - GENERAL

1.01 **DESCRIPTION**

A. **SCOPE:** The **General Conditions of the Contract for Construction**, AIA Document A201, Seventeenth Edition, 2017, Articles 1 through 15 inclusive, is a part of this Contract and is incorporated herein.

B. **BIDDING COPY:** For the purpose of bidding, Contractors are presumed to be familiar with AIA Document A201, a copy of which may be obtained from the Professional, or examined in the Professional's office.

***** END OF SECTION *****

# SUPPLEMENTARY CONDITIONS
## SECTION 00 7300

### PART 1 – GENERAL

1.01 **Description**

A. **Owner:** These supplements are necessary because the Owner is an agency, or political subdivision, of the State of Mississippi and occupies a different position from that of the usual Owner.

B. **Document:** The following supplements modify, change, delete from, or add to the **General Conditions of the Contract**, AIA Document A201, Seventeenth Edition, 2017. When any Article of the **General Conditions** is modified, or deleted, by these *Supplementary Conditions*, the unaltered provisions of that Article, Paragraph, Subparagraph, or Clause will remain in effect.

### Article 1
### GENERAL PROVISIONS

1.1 **Basic Definitions**

1.1.1 **The Contract Documents**

Change this subparagraph to read as follows:

*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 Special Conditions), Drawings, Specifications and Addenda issued prior to the execution of the Contract, 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 minor changes in the Work issued by the Prime Professional. The Contract Documents also include the advertisement or invitation for bids or proposals, Instructions to Bidders, and the Contractor's bid or proposal.*

1.1.2 **The Contract**

Change each instance of the word "*Architect*" to "*Prime Professional*" and each instance of the word "*Architect's*" to "*Prime Professional's*".

1.1.7 **Instruments of Service**

Change the word "*Architect*" to "*Prime Professional*" and change the word "*Architect's*" to "Prime Professional's".

1.1.8 **Initial Decision Maker**

Change this Subparagraph to read as follows:

*The Initial Decision Maker is the person identified as the Professional in Paragraph 5.3.1 of the Standard Form of Agreement Between the Owner and the Contractor and will render initial decisions on Claims in accordance with Section 15.2.*

1.1.9 Add a new Subparagraph as follows:

***Commissioning Authority Professional***
*A professional independent of the Prime Professional retained by the owner who manages a quality-focused process for enhancing the delivery of the project. The process focuses upon verifying and documenting that the facility and all of its systems are planned, designed, installed, tested, operated, and maintained to meet the Owner's project requirements.*

1.2.1 Change this Subparagraph to read as follows:

*The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor and unless otherwise provided in the Contract Documents, this shall include all labor, materials, equipment, tools, machinery, water, heat, utilities, transportation, and other facilities and services, whether temporary or permanent and whether or not incorporated in the Work. 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. In case of any direct conflict among the Contract Documents, the specifications shall take precedence over the drawings, supplemental or special conditions shall take precedence over more general conditions or requirements, details shall take precedence over plans, and larger scale drawings shall take precedence over smaller scale drawings.*

1.5 **Ownership and Use of Drawings, Specifications, and Other Instruments of Service**

1.5.1 Change each instance of the word "*Architect*" to "*Prime Professional*" and each instance of the word "*Architect's*" to "*Prime Professional's*" and add a new sentence at the end of this Subparagraph:

*This Paragraph in no way supersedes the Owner's document rights set forth in the separate Agreement Between the Owner and the Professional.*

1.5.3 Add a new Subparagraph as follows:

***Transparency***
*In accordance with the Mississippi Accountability and Transparency Act of 2008, §27-104-151, et seq., of the Mississippi Code of 1972, as Amended, the American Accountability and Transparency Act of 2009 (P.L. 111-5), where applicable, and §31-7-13 of the Mississippi Code of 1972, as amended, where applicable, a fully executed copy of this agreement shall be posted to the State of Mississippi's accountability website at: https://www.transparency.mississippi.gov*

1.6 **Notice**

1.6.1 Change this Subparagraph to read as follows:

*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 address and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if transmitted to the government or business issued e-mail address of the respective party.*

1.7 **Digital Data Use and Transmission**

Delete the last sentence of this Paragraph.

1.8 **Building Information Models Use and Reliance**

Change this Paragraph to read as follows:

*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 a written documents 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.*

## Article 2
## OWNER

2.1 **General**

2.1.1 Change this Subparagraph to read as follows:

*The Owner, as used in these Documents, refers to the Bureau of Building, Grounds and Real Property Management, acting for and on behalf of the State of Mississippi and for the benefit of the Institution, Agency, or Department for which the Work under this Contract is being performed. The Owner is the entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner's representative, who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization, is the individual who signed the Agreement Between the Owner and the Contractor, his successor in the case of that individual's retirement or termination, or his direct supervisor in the case of that individual's absence. Except as otherwise provided in Subparagraph 4.2.1, the Prime Professional does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.*

2.1.2 Delete this Subparagraph in its entirety.

2.2 **Evidence of the Owner's Financial Arrangements**

2.2.1 Delete this Subparagraph in its entirety.

2.2.2 Delete this Subparagraph in its entirety.

2.3.1 Delete this Subparagraph in its entirety.

2.2.3 Delete this Subparagraph in its entirety.

2.2.4 Delete this Subparagraph in its entirety.

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

2.3.2 Add the word "*or Engineer*" following each instance of the word "*Architect*" and add the words "*or engineering respectively*" following each instance of the word "*architecture*".

2.3.3 Add the word "*or Engineer*" following each instance of the word "*Architect.*

2.3.6 Change this Subparagraph to read as follows:

*Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, such copies of Drawings and Project Manuals as are reasonably necessary, but in no instance to exceed twenty-five (25) copies, for the execution of the Work.*

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

Change this Subparagraph to read as follows:

*If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents as required by Section 12.2 or fails to carry out Work in accordance with the Contract Documents, the Owner may issue, or direct the Prime Professional to 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. The rights and remedies under this Subparagraph are in addition to and do not in any respect limit any other rights of the Owner, including the right to terminate in accordance with Article 14.*

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

Change this Paragraph read as follows:

*If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-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 predjudice to other remedies the Owner may have, correct such default or neglect. The Prime Professional 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 Prime Professional'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 Prime Professional, 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**

3.1.3 Change the word "*Architect*" to "*Prime Professional*" and change the word "*Architect's*" to "*Prime Professional's*".

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

3.2.2 Change each instance of the word "*Architect*" to "*Prime Professional*".

3.2.3 Change each instance of the word "*Architect*" to "*Prime Professional*".

3.2.4 Change the word "*Architect*" to "*Prime Professional*".

3.3 **Supervision and Construction Procedures**

3.3.1 Change each instance of the word "*Architect*" to "*Prime Professional*".

3.4 **Labor and Materials**

3.4.2 Change each instance of the word "*Architect*" to "*Prime Professional*" and add the words "*where such substitution results in a modification of the Contract Sum or Contract Time*" to the end of this sentence.

3.4.4 Add a new Subparagraph as follows:

***Employee Status Verification System*** *If applicable, the Contractor represents and warrants that it will ensure its compliance with the Mississippi Employment Protection Act, Section 71-11-1, et seq. of the Mississippi Code Annotated (Supp 2008), and will register and participate in the status verification system for all newly hired employees. The term "employee" as used herein means any person that is hired to perform work within the State of Mississippi. As used herein, "status verification system" means the Illegal Immigration Reform and Immigration Responsibility Act of 1996 that is operated by the United States Department of Homeland Security, also known as the E-Verify Program, or any other successor electronic verification system replacing the E-Verify Program. The Contractor agrees to maintain records of such compliance and, upon request of the State and approval of the Social Security Administration or Department of Homeland Security, where required, to provide a copy of each such verification to the State. The Contractor further represents and warrants that any person assigned to perform services hereunder meets the employment eligibility requirements of all immigration laws of the State of Mississippi. The Contractor understands and agrees that any breach of these warranties may subject the Contractor to the following: (a) termination of this Agreement and ineligibility for any state or public contract in Mississippi for up to three (3) years, with notice of such cancellation/termination being made public, or (b) the loss of any license, permit, certification or other document granted to the Contractor by an agency, department or governmental entity for the right to do business in Mississippi for up to one (1) year, or (c) both. In the event of such cancellation/termination, the Contractor would also be liable for any additional costs incurred by the State due to the contract cancellation or loss of license or permit.*

3.4.5 Add a new Subparagraph as follows:

*In providing labor for the proper execution and completion of the Work, the Contractor shall comply with the provisions of Section 31-5-19 of the Mississippi Code of 1972, Annotated.*

3.4.6 Add a new Subparagraph as follows:

*In providing materials for the proper execution and completion of the Work, the Contractor shall comply with the provisions of Section 31-5-23 of the Mississippi Code of 1972, Annotated.*

3.5 **Warranty**

3.5.1 Change each instance of the word "*Architect*" to "*Prime Professional*".

3.7 **Permits, Fees, Notices and Compliance with Laws**

3.7.1 Change this Subparagraph to read as follows:

*Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for any applicable permits, fees, licenses, and inspections by government agencies necessary for the 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.*

3.7.3 Delete the words "*knowing it to be*" from this Subparagraph.

3.7.4 Change each instance of the word "*Architect*" to "*Prime Professional*" and change the word "*Architect's*" to "*Prime Professional's*".

3.7.5 Change the word "*Architect*" to "*Prime Professional*".

3.9 **Superintendent**

3.9.2 Change this Subparagraph to read as follows:

*The Contractor, as soon as practicable after award of the Contract, and prior to commencement of any on-site Work, shall notify the Owner and Prime Professional of the name, qualifications and references of the proposed superintendent and any assistant superintendents where provided for in the Contract Documents. Within 14 days of receipt of the information, the Prime Professional shall notify the Contractor stating whether the Owner or the Prime Professional (1) has reasonable objection to the proposed superintendent based upon information provided or other requirements provided for in the Contract Documents or (2) requires additional information or time for review. Failure of the Prime Professional to respond within the 14-day period shall constitute notice of no reasonable objection.*

3.9.3 Change the word "*Architect*" to "*Prime Professional*".

3.10 **Contractor's Construction and Submittal Schedules**

3.10.1 Change this Subparagraph to read as follows:

*The Contractor, promptly after being awarded the Contract, and no later than fifteen days after the date established in the Notice to Proceed, shall submit for the Owner's and Prime Professional'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 the time limits current under the Contract Documents. Submission of a schedule that indicates or expresses an intent to complete Work prior to the time limits established by the Contract Documents shall not make the Owner liable to the Contractor for any failure to achieve early completion or obligate the Owner to take or prevent any actions to facilitate the Contractor's completion prior to the expiration of the Contract Time. The schedule shall be revised monthly or at more frequent intervals as required by the conditions of the Work and Project.*

3.10.2 Change each instance of the word "*Architect's*" to "*Prime Professional's*" and change the word "*Architect*" to "*Prime Professional*".

3.10.3 Change the word "*Architect*" to "*Prime Professional*".

3.11 **Documents and Samples at the Site**

Change each instance of the word "*Architect*" to "*Prime Professional*".

3.12 **Shop Drawings, Product Data and Samples**

3.12.4 Change each instance of the word "*Architect*" to "*Prime Professional*".

3.12.5 Change each instance of the word "*Architect*" to "*Prime Professional*".

3.12.6 Change the word "*Architect*" to "*Prime Professional*".

3.12.7 Change the word "*Architect*" to "*Prime Professional*".

3.12.8 Change each instance of the word "*Architect's*" to "*Prime Professional's*" and change the word "*Architect*" to "*Prime Professional*".

3.12.9 Change the word "*Architect*" to "*Prime Professional*" and change the word "*Architect's*" to "*Prime Professional's*".

3.12.10.1 Change each instance of the word "*Architect*" to "*Prime Professional*".

3.12.10.2 Change each instance of the word "*Architect*" to "*Prime Professional*".

3.15 **Cleaning Up**

3.15.2 Change this Subparagraph to read as follows:

*If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be assessed to the Contractor.*

3.16 **Access to Work**

Change this Paragraph to read as follows:
*The Contractor shall provide the Owner, Prime Professional, Commissioning Authority Professional, Separate Contractors and their authorized representatives with access to the Work in preparation and progress wherever located. This shall include the provision of lifts, ladders, scaffolding and/or equivalent for access to elevated work.*

3.17 **Royalties, Patents and Copyrights**

Change each instance of the word "*Architect*" to "*Prime Professional*".

3.18 **Indemnification**

3.18.1 Change this Subparagraph to read as follows:

*To the fullest extent allowed by law, Contractor shall indemnify, defend, save and hold harmless, protect, and exonerate the Owner, Prime Professional, Prime Professional's consultants, Commissioning Authority Professional, Commissioning Authority Professional's consultants, as well as the State of Mississippi, its Commissioners, Board Members, officers, employees, agents, and representatives, from and against all claims, demands, liabilities, suits, actions, damages, losses, and costs of every kind and nature whatsoever, including, without limitation, court costs, investigative fees and expenses, and attorneys' fees, arising out of or caused by Contractor's and/or its partners, principals, agents, employees, and/or subcontractors in the performance of or failure to perform this Agreement. In the State's sole discretion, Contractor may be allowed to control the defense of any such claim, suit, etc. In the event Contractor defends said claim, suit, etc., Contractor shall use legal counsel acceptable to the State; Contractor shall be solely liable for all reasonable costs and/or expenses associated with such defense and the State shall be entitled to participate in said defense. Contractor shall not settle any claim, suit, etc., without the State's concurrence, which the State shall not unreasonably withhold.*
.

## Article 4
## ARCHITECT

Change the title of this article from "*ARCHITECT*" to "*PRIME PROFESSIONAL*".

4.1 **General**

4.1.1 Change this Subparagraph to read as follows:

*The Prime Professional is the person identified as the Professional in the Agreement Between the Owner and the Contractor and retained by the Owner pursuant to Section 2.3.2.*

4.1.2 Change each instance of the word "*Architect*" to "*Prime Professional*".

4.2 **Administration of the Contract**

4.2.1 Change the first line of this Subparagraph to read as follows:

*The Prime Professional will provide administration of the Contract as described in the Contract Documents, and will be the Owner's representative during construction until the end of the period for correction of Work as described in Section 12.2.*

4.2.2 Change each instance of the word "*Architect*" to "*Prime Professional*".

4.2.3 Change each instance of the word "*Architect*" to "*Prime Professional*".

4.2.4 Change each instance of the word "*Architect*" to "*Prime Professional*" and each instance of the word "*Architect's*" to "*Prime Professional's*".

4.2.5 Change the word "*Architect's*" to "*Prime Professional's*" and change the word "*Architect*" to "*Prime Professional*".

4.2.6 Change each instance of the word "*Architect*" to "*Prime Professional*".

4.2.7 Change each instance of the word "*Architect*" to "*Prime Professional*" and each instance of the word "*Architect's*" to "*Prime Professional's*".

4.2.8 Change each instance of the word "*Architect*" to "*Prime Professional*".

4.2.9 Change the word "*Architect*" to "*Prime Professional*".

4.2.10 Change each instance of the word "*Architect*" to "*Prime Professional*" and the word "*Architect's*" to "*Prime Professional's*".

4.2.11 Change the word "*Architect*" to "*Prime Professional*" and the word "*Architect's*" to "*Prime Professional's*".

4.2.12 Change each instance of the word "*Architect*" to "*Prime Professional*".

4.2.13 Change the word "*Architect's*" to "*Prime Professional's*".

4.2.14 Change each instance of the word "*Architect*" to "*Prime Professional*".

## Article 5
## SUBCONTRACTORS

5.2 **Award of Subcontracts and Other Contracts for Portions of the Work**

5.2.1 Change this Subparagraph to read as follows:

*Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, prior to award of the Contract by the Owner, shall furnish in writing to the Owner through the Prime Professional, the names, classifications, and COR #'s of Sub-Contractors over Fifty Thousand Dollars ($50,000.00) (as well as entities who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. Such list shall also include any Mechanical, Plumbing, or Electrical Sub-Contractor as listed on Proposal Form regardless of amount. Within 7 days of receipt of the information, the Prime Professional shall notify the Contractor whether the Owner or the Prime Professional (1) has reasonable objection to any such proposed Sub-Contractor or entity based upon information provided or other requirements provided for in the Contract Documents or (2) requires additional information or time for review. Failure of the Prime Professional to respond within the 7-day period shall constitute notice of no reasonable objection. Where a Project involves a Mississippi Landmark or a building and/or site potentially eligible for such designation, the Contractor shall also furnish documentation that all Sub-Contractors, regardless of Sub-Contract amount, have at least the minimum*

*number of years of successful experience specified by the Prime Professional in work on previous projects involving State or National Landmarks of similar type, scale and complexity and that all key personnel to be utilized to perform the Work are experienced craftsmen with not less than five (5) years of experience.*

5.2.2 Change this Subparagraph to read as follows:

*The Contractor shall not contract with a proposed Sub-Contractor or entity to whom the Owner or Prime Professional has made reasonable and timely objection. Other than the Mechanical, Plumbing, or Electrical Sub-Contractors as listed on the Proposal Form, the Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection. Only where the listed Mechanical, Plumbing, or Electrical Sub-Contractor has (1) closed their business (2) entered into bankruptcy or (3) refuses to enter into a contract with the Contractor will substitution of such Sub-Contractor be permitted prior to the execution of the Agreement Between the Owner and Contractor. Substitution for refusal to enter into contract shall not be permitted if the reason for such refusal is due to unilateral reduction by Contractor of such Sub-Contractor's bid price.*

5.2.3 Change this Subparagraph to read as follows:

*If the Owner or Prime Professional has reasonable objection to a Sub-Contractor or entity proposed by the Contractor, other than the Mechanical, Plumbing, or Electrical Sub-Contractors as listed on the Proposal Form, the Contractor shall propose another to whom the Owner or Prime Professional has no reasonable objection. Neither the Contract Sum nor Contract Time may be increased or decreased due to any change in Sub-Contractor or entity. Failure of Contractor to identify Sub-Contractors or entities to whom the Owner and Prime Professional have no reasonable objections within 10 working days of initial submission shall result in the bid or proposal being deemed non-responsible at which time the Owner may elect to award to the next lowest responsive, responsible bidder or resolicit the project.*

5.2.4 Change this Subparagraph to read as follows:

*Following the execution of the Agreement Between the Owner and Contractor, the Contractor shall not substitute a Sub-Contractor or entity for one previously selected if the Owner or Prime Professional makes reasonable objection to such substitution. In no case shall substitution of Mechanical, Plumbing or Electrical Sub-Contractors be permitted except where such Sub-Contractor has (1) closed their business (2) entered into bankruptcy (3) becomes in arrears or (4) becomes involved in an ongoing dispute with the Contractor related to the Sub-Contractor's execution, workmanship, or timely performance of their potion of the Work.*

## Article 6
## CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.2.2 Change each instance of the word "*Architect*" to "*Prime Professional*".

6.3 Change the word "*Architect*" to "*Prime Professional*".

## Article 7
## CHANGES IN THE WORK

7.2 **Change Orders**

7.2.1 Change each instance of the word "*Architect*" to "*Prime Professional*".

7.2.2 Add a new Subparagraph as follows:

*The maximum mark-up included in a Change Order for profit and overhead is limited to twenty percent (20%) of the total of the actual cost for materials, labor and subcontracts. Profit and overhead include: all taxes, fees, permits, insurance, bond, job superintendent, job and home office expense. All Sub-Contractors and Sub-Sub-Contractors shall acquiesce to the same requirements when participating in a Change Order.*

7.3 **Construction Change Directives**

7.3.4 Change the word "*Architect*" to "*Prime Professional*".

7.3.4.1 Change the word "*Architect*" to "*Prime Professional*".

7.3.6 Change this Subparagraph to read as follows:

*Upon receipt of a Construction Change Directive signed by the Prime Professional and the Owner, the Contractor shall promptly proceed with the change in the Work and advise the Prime Professional 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 Change this Subparagraph to read as follows:

*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 become effective once signed by the Prime Professional and the Owner and will subsequently be incorporated into a Change Order.*

7.3.8 Change the word "*Architect*" to "*Prime Professional*".

7.3.9 Change this Subparagraph to read as follows:

*Until such time that a Construction Change Directive is recorded as a Change Order, the Contractor may not request payment for Work completed under the Construction Change Directive in Applications for Payment.*

7.3.10 Change each instance of the word "*Architect*" to "*Prime Professional*".

7.4 Change each instance of the word "*Architect*" to "*Prime Professional*" and the word "*Architect's*" to "*Prime Professional's*".

## Article 8
## TIME

8.1 **Definitions**

8.1.2 Change this Subparagraph to read as follows:

*The date of commencement of the Work is the date established in the Notice to Proceed.*

8.1.3 Change the word "*Architect*" to "*Prime Professional*".

8.2 **Progress and Completion**

8.2.1 Change this Subparagraph to read as follows:

*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 and acknowledges that such period includes time for all applicable submittals, selections, reviews, approvals, inspections, meetings, as well as discovery and investigation of any latent conditions.*

8.2.2 Change this Subparagraph to read as follows:

*The Contractor shall not knowingly commence the Work prior to the date established in the Notice to Proceed or the effective dates of bond and insurance required to be furnished by the Contractor.*

8.3 **Delays and Extensions of Time**

8.3.1 Change this Subparagraph to read as follows:

*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 Prime Professional, of an employee of either, or of a Separate Contractor; (2) by labor disputes, pandemics, acts of terrorism, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions in excess of any weather days otherwise provided for in the Contract Documents that are documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (3) by delay authorized by the Owner pending dispute resolution; or (4) by other causes that the Contractor asserts, and the Owner, in consultation with the Prime Professional determines justify delay, then the Contract Time shall be extended for such reasonable time as the Owner, in consultation with the Prime Professional, may determine. Such determination shall take into consideration the critical path of the Work and will be reduced by any float in the Contractor's Construction Schedule that does not affect the overall completion of the Work. Except where such delay is due to suspension by the Owner in accordance with Article 14 or such delay has the effect of stopping all progress of the Work for 14 calendar days or more, the Contract Sum will not be increased for additional general overhead expenses; however, it may be increased for direct expenses directly related to the delay of specific portions of the Work so delayed. Any claim for loss or any delay occasioned by any Sub-Contractor or entity under contract with the Contractor, shall be settled between the Contractor and such other Sub-Contractor or entity.*

## Article 9
## PAYMENTS AND COMPLETION

9.2 **Schedule of Values**

Change this Paragraph to read as follows:

*Where the Contract is based on a stipulated sum, the Contractor shall submit a schedule of values to the Prime Professional, at least 10 working days before the first Application for Payment, a schedule of values allocating the entire 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 Prime Professional. This schedule, unless objected to by the Prime Professional or Owner, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any subsequent changes to the schedule of values shall be submitted to the Prime Professional and supported by such data to substantiate its accuracy as the Prime Professional may require, and unless object to by the Prime Professional or Owner, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.*

9.3 **Applications for Payment**

9.3.1 Add a new sentence to the end of this Subparagraph:

*The form of Application for Payment will be AIA Document G702, Application and Certification for Payment, supported by AIA Document G703, Continuation Sheet, or a computer generated form containing similar data.*

9.3.1.1 Delete this Subparagraph in its entirety.

9.3.1.3 Add a new Clause to Subparagraph 9.3.1 as follows:
*On any contract as described herein, of which the total amount is Two Hundred Fifty Thousand Dollars ($250,000.00) or greater, or on any contract with a subcontractor, regardless of amount, five percent (5%) shall be retained until the Work is at least fifty percent (50%) complete, on schedule and satisfactory in the Prime Professional's opinion, at which time fifty percent (50%) of the retainage held to date shall be returned, subject to consent of surety, to the prime contractor for distribution to the appropriate subcontractors and suppliers; provided, however, that future retainage shall be withheld at the rate of two and one-half percent (2 1/2%). When submitting request for reduction in retainage, the Contractor will include, with the application, a Consent of Surety to Reduction which is AIA Form G707A, and a Power of Attorney. (Code 31-5-33)*

9.3.1.4 Add a new Clause to Subparagraph 9.3.1 as follows:

*The Contractor must submit each month with this Application for Payment a separate letter stating that he is requesting an extension of time or that he had no need for an extension for that period of time. No payment on a monthly application will be considered due and payable until the letter is received. Complete justification such as weather reports or other pertinent correspondence must be included for each day's request for extension. A Contractor's letter, or statement, will not be considered as adequate justification. The receipt of this request and data by the Owner will not be considered as approval of the Owner or Prime Professional in any way.*

9.3.2.1 Add a new Clause to Subparagraph 9.3.2 as follows:

*Payment in an amount not greater than the documented cost paid by the Contractor for ~~on~~ materials stored at some location other than the Project site, may be approved by the Prime Professional and the Owner after the Contractor has submitted the following items:*

*.1 An acceptable Lease Agreement between the General Contractor and the owner of the land, or building, where the materials are stored covering the specific area where the materials are located.*
*.2 Consent of Surety, or other acceptable Bond, to cover the materials stored off-site.*
*.3 All Perils Insurance coverage for the full value of the materials stored off-site.*
*.4 A Bill of Sale from the Manufacturer to the General Contractor for the stored materials.*
*.5 A complete list and inventory of materials manufactured, stored and delivered to the storage site and of materials removed from the storage site and delivered to the job site.*
*.6 A review by the Prime Professional of the materials stored off-site prior to release of payment. Where the storage location is greater than 50 miles of the building site, the Contractor shall pay or reimburse reasonable travel costs of the Prime Professional and/or his Consultants for such review.*
*.7 Guarantee no storage costs, additional delivery fees, or subsequent costs to the Owner.*

9.4 **Applications for Payment**

9.4.1 Change each instance of the word "*Architect*" to "*Prime Professional*" and the word "*Architect's*" to "*Prime Professional's*".

9.4.2 Change each instance of the word "*Architect*" to "*Prime Professional*" and each instance of the word "*Architect's*" to "*Prime Professional's*".

9.5 **Decisions to Withhold Certification**

9.5.1 Change each instance of the word "*Architect*" to "*Prime Professional*" and the word "*Architect's*" to "*Prime Professional's*".

9.5.1.7 Delete the word "*repeated*" from this Clause.

9.5.2 Change the word "*Architect*" to "*Prime Professional*".

9.5.3 Delete this Subparagraph in its entirety.

9.5.4 Change each instance of the word "*Architect*" to "*Prime Professional*".

9.6 **Progress Payments**

9.6.1 Change each instance of the word "*Architect*" to "*Prime Professional*".

9.6.2 Change the first line of this Subparagraph to read as follows:

*The Contractor shall pay each Sub-Contractor and material supplier, in accordance with Section 31-5-27 of the Mississippi Code 1972, Annotated, in proportion to the percentage of work completed by each less applicable retainage.*

9.6.3 Change each instance of the word "*Architect*" to "*Prime Professional*".

9.6.4 Change the word "*Architect*" to "*Prime Professional*".

9.6.9 Add a new Subparagraph as follows:

*The amount retained by the Contractor from each payment to each Sub-Contractor and material supplier shall not exceed the percentage retained by the Owner from the Contractor.*

9.6.9.1 Add a new Clause to Subparagraph 9.6.9 as follows:

*The Contractors shall submit monthly certification, in accordance with Section 31-5-25 of the Mississippi Code 1972, Annotated, on Owner's "Affidavit Certifying Payment to All Subcontractors" form, to the Prime Professional indicating payments to subcontractors on prior payment request.*

9.6.10 Add a new Subparagraph as follows:

*The Owner agrees to make payment in accordance with Mississippi Law on "Time for full and final payment to contractors; exemptions; monthly submission by contractors of proof of payment to subcontractors", Section 31-5-25 of the Mississippi Code of 1972, Annotated, which generally provides for payment of undisputed amounts within forty-five (45) days of when they are due and payable. Payments by state agencies using the statewide electronic payment and remittance vehicle shall be made and remittance information provided electronically as directed by the State. These payments shall be deposited into the bank account of the Contractor's choice. Contractor understands and agrees that the State is exempt from the payment of taxes. All payments shall be in United States currency. No payment, including final payment, shall be construed as acceptance of defective or incomplete work, and the Contractor shall remain responsible and liable for full performance.*

9.7 **Failure of Payment**

Change this Paragraph to read as follows:

*The Contractor and the Owner shall be subject to the remedies as prescribed in Section 31-5-25 of the Mississippi Code 1972, Annotated.*

9.8 **Substantial Completion**

9.8.1 Add the following sentence to the end this Subparagraph to read as follows:

*In order to be considered occupiable or utilizable by the Owner, all life safety systems must be operable and tested and the commissioning requirements for the Work or designated portion thereof must be complete except for thermographs of electrical systems, trend log monitoring, seasonal testing, near-warranty end activities and verification of training sessions.*

9.8.3 Change this Subparagraph to read as follows:

*Upon receipt of the Contractor's list, the Prime Professional will promptly visit the site to determine whether the Work or designated portion thereof is substantially complete. If, in the opinion of the Prime Professional, the Work or designated portion thereof is not substantially complete, the Prime Professional will not proceed with inspection and the Prime Professional will report the reasons for such determination to the Contractor. In such case, the Contractor shall then submit a revised list and request for inspection when these reasons have been resolved.*

9.8.4 Change this Subparagraph to read as follows:

*When the Work or designated portion thereof is substantially complete and affirmed by the Owner, the Prime Professional will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance,*

*and shall fix the time within which the Contractor shall finish all items on the punch list accompanying the Certificate. Unless otherwise provided in the Contract Documents, 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.*

9.9 **Partial Occupancy or Use**

9.9.1 Change each instance of the word "*Architect*" to "*Prime Professional*".

9.9.2 Change the word "*Architect*" to "*Prime Professional*".

9.10 **Final Completion and Final Payment**

9.10.1 Change this Subparagraph and add the associated Clauses to read as follows:

*When, in the opinion of the Contractor, the Work is ready for final inspection and acceptance by the Owner, the Contractor shall make such notice to the Prime Professional.*

1. *Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance by the Owner, the Prime Professional will promptly visit the site and assess the state of the Work to determine if it is ready for final inspection by the Owner. If, in the Prime Professional's judgment, the Work is not ready for final inspection, the Prime Professional will report the reasons for such determination to the Contractor. In such case, the Contractor shall then submit a revised request for final inspection when these reasons have been resolved.*

2. *Once the Prime determines the Work is ready for final inspection, the Prime Professional will call for final inspection of the with the Owner for the purpose of determining whether the Work is acceptable under the Contract Documents.*
3. *The final inspection shall be conducted in the presence of the Owner and a list of defects or discrepancies, if any, will be compiled into a final punch list furnished to all parties.*
4. *Once corrections of all final punch list items have been confirmed by the Prime Professional, the Prime Professional will provide a letter recommending final acceptance of the Work to the Owner.*

9.10.2 Change this Subparagraph to read as follows:

*Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Prime Professional (1) final application for payment, (2) consent of surety to final payment, (3) power of attorney, (4) Contractor's affidavit of release of liens, (5) Contractor's affidavit of payment of debts and claims, (6) Contractor's guarantee of work, (7) Project Record Documents and (8) certificates, warranties, guarantees, bonds or documents as called for in the individual sections of the Project Manual. The final payment will be reduced by the value of any amounts assessed to the Contractor per Section 2.5 Owner's Right to Carry Out the Work, Section 6.3 Owners Right to Clean Up, or Section 9.11 Liquidated Damages where such amounts have not been reconciled by a Change Order per Section 7.2 prior to final acceptance unless such amounts have been resolved via separate agreement(s) between the Owner and the Contractor.*

9.11 **Liquidated Damages**

9.11.1 Add a new Paragraph as follows:

*Time being of the essence and a matter of material consideration thereof, a reasonable estimate in advance is established to cover losses incurred by the Owner if the project is not substantially complete on the date set forth in the Contract Documents. The Contractor and his Surety will be liable for and will be assessed by the Owner the sums stipulated in Paragraph 2.2 of the Standard Form of Agreement Between the Owner and the Contractor as fixed and agreed as liquidated damages for each calendar day of delay until the work is substantially complete unless circumstances dictate otherwise in the discretion of the Owner. The Contractor and his Surety acknowledge that losses to the Owner caused by the delay of the Contractor are not readily ascertainable and that the amount estimated per day and established as liquidated damages is reasonable and not a penalty.*

## Article 10
## PROTECTION OF PERSONS AND PROPERTY

10.2 **Safety of Persons and Property**

10.2.5 Change this Subparagraph to read as follows:

*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 Clauses 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Sub-Contractor, a Sub-Sub-Contractor, 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 for Clauses 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss attributable to acts or omissions of the Owner or Prime Professional and not attributable to the fault or negligence of the Contractor. Where damage or loss is insured under property insurance required by the Contract Documents, the Contractor shall promptly report, file and facilitate the claim process so as to minimize any impacts on the timely completion of the Work. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Paragraph 3.18.*

10.3 **HAZARDOUS MATERIALS**

10.3.2 Delete this Subparagraph in its entirety.

10.3.3 Delete this Subparagraph in its entirety.

10.3.4 Delete this Subparagraph in its entirety.

10.3.5 Delete this Subparagraph in its entirety.

10.3.6 Delete this Subparagraph in its entirety.

## Article 11
## INSURANCE AND BONDS

11.1 **Contractor's Insurance and Bonds**

11.1.1 Add a sentence to the end of this Subparagraph as follows:

*Insurance shall be purchased to protect the Contractor from claims set forth below for not less than the limits of liability specified below or required by law, whichever coverage is greater, which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Sub-Contractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:*

Add new Clauses as follows:

*.1 GENERAL LIABILITY:*
*Commercial General Liability*
*(Including XCU)*

| | | |
|---|---|---|
| *General Aggregate* | *$* | *1,000,000.00 Aggregate* |
| *Products & Completed Operations* | *$* | *1,000,000.00 Aggregate* |
| *Personal & Advertising Injury* | *$* | *500,000.00 Per Occurrence* |
| *Bodily Injury & Property Damage* | *$* | *1,000,000.00 Per Occurrence* |
| *Fire Damage Liability* | *$* | *50,000.00 Per Occurrence* |
| *Medical Expense* | *$* | *5,000.00 Per Person* |

*.2 OWNERS & CONTRACTORS PROTECTIVE LIABILITY:*

| | | |
|---|---|---|
| *Bodily Injury & Property Damage* | *$* | *1,000,000.00 Aggregate* |
| *Bodily Injury & Property Damage* | *$* | *500,000.00 Per Occurrence* |

*.3 AUTOMOBILE LIABILITY:*
*(Owned, Non-owned & Hired Vehicles)*
*Contractor Insurance Option Number 1:*

| | | |
|---|---|---|
| *Bodily Injury & Property Damage* | *$* | *500,000.00 Per Occurrence* |
| *(Combined Single Limit)* | | |
| *Contractor Insurance Option Number 2:* | | |
| *Bodily Injury* | *$* | *250,000.00 Per Person* |
| *Bodily Injury* | *$* | *500,000.00 Per Accident* |
| *Property Damage* | *$* | *100,000.00 Per Occurrence* |

*.4 EXCESS LIABILITY:*
*(Umbrella on projects over $500,000)*

| | | |
|---|---|---|
| *Bodily Injury & Property Damage* | *$* | *1,000,000.00 Aggregate* |
| *(Combined Single Limit)* | | |

*.5 WORKERS' COMPENSATION:*
*(As required by Statute)*
*EMPLOYERS' LIABILITY:*

| | | |
|---|---|---|
| *Accident* | *$* | *100,000.00 Per Occurrence* |
| *Disease* | *$* | *500,000.00 Policy Limit* |
| *Disease* | *$* | *100,000.00 Per Employee* |

*.6 PROPERTY INSURANCE:*

| | | |
|---|---|---|
| *Builder's Risk* | *$* | *Equal to Value of Work* |
| *or* | | |
| *Installation Floater* | *$* | *Equal to Value of Work* |

11.1.5 Add a new Subparagraph to read as follows:

*Insurance shall be maintained without interruption from the date of commencement of the Work until the date of final payment unless otherwise noted on the Certificate of Substantial Completion.*

11.1.6 Add a new Subparagraph to read as follows:

*Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to final execution of the Contract and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. Information concerning reduction of coverage on account of revised limits or clams paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.*

11.1.7 Add a new Subparagraph as follows:

*If the coverages are provided on a claims-made basis, the policy date or retroactive date shall predate the Contract; the termination date, or the policy, or applicable extended reporting period shall be no earlier than the termination date of coverages required to be maintained after final payment.*

11.1.8 Add a new Subparagraph as follows:

*If any insurance requires deductibles, the Contractor shall pay costs not covered because of such deductibles.*

11.1.9 Add a new Subparagraph as follows:

*The Owner as fiduciary shall have power to adjust and settle a loss with Insurers unless one of the parties in interest shall object in writing within five (5) days after occurrence of loss.*

11.2 **Owner's Insurance**

Delete this Paragraph in its entirety and substitute the following:

*The Contractor shall purchase and maintain such insurance as will protect the Owner from his contingent liability to others for damages because of bodily injury, including death, and property damage, which may arise from operations under this Contract and other liability for damages which the Contractor is required to insure under any provision of this Contract. Certificate of this insurance will be filed with the Owner and will be the same limits set forth in 11.1.5.*

11.2.1 Delete this Subparagraph in its entirety.

11.2.2 Delete this Subparagraph in its entirety.

11.2.3 Delete this Subparagraph in its entirety.

11.3 **Waivers of Subrogation**

11.3.1 Delete this Subparagraph in its entirety.

11.3.2 Delete this Subparagraph in its entirety.

11.5 **Adjustment and Settlement of Insured Loss**

11.5.1 Delete this Subparagraph in its entirety.

11.5.2 Delete this Subparagraph in its entirety.

## Article 12
## UNCOVERING AND CORRECTION OF WORK

12.1 **Uncovering of Work**

12.1.1 Change each instance of the word "*Architect's*" to "*Prime Professional's*", change the word "*Architect*" to "*Prime Professional*", and add the words "*or Contract Sum*" at the end of this sentence.

12.1.2 Change each instance of the word "*Architect*" to "*Prime Professional*".

12.2 **Correction of Work**

12.2.1 Change the word "*Architect*" to "*Prime Professional*" and the word "*Architect's*" to "*Prime Professional's*".

12.2.2.1 Change the word "*Architect*" to "*Prime Professional*".

## Article 13
## MISCELLANEOUS PROVISIONS

13.1 **Governing Law**

Change this Paragraph to read as follows:

*The Contract shall be governed by the laws of the State of Mississippi.*

13.3 **Rights and Remedies**

13.3.2 Change the word "*Architect*" to "*Prime Professional*".

13.4 **Tests and Inspections**

13.4.1 Change each instance of the word "*Architect*" to "*Prime Professional and Commissioning Authority Professional*".

13.4.2 Change the first two instances of the word "*Architect*" to "*Prime Professional*" and the second two instances of the word "*Architect*" to "*Prime Professional and Commissioning Authority Professional*".

13.4.3 Change the word "*Architect*" to "*Prime Professional's and Commissioning Authority Professional's*".

13.4.5 Change each instance of the word "*Architect*" to "*Prime Professional and/or the Commissioning Authority Professional*".

13.5 Delete this Paragraph in its entirety.

## Article 14
## TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 **Termination by the Contractor**

14.1.1.3 Change the word "*Architect*" to "*Prime Professional*".
14.1.1.4 Delete this Clause in its entirety.

14.1.3 Change the word "*Architect*" to "*Prime Professional*".

14.1.4 Change the word "*Architect*" to "*Prime Professional*".

14.2 **Termination by the Owner for Cause**

14.2.1.1 Delete the word "*repeatedly*" from this Clause.

14.2.1.3 Delete the word "*repeatedly*" from this Clause.

14.2.1.3 Delete the word "or" from this Clause.

14.2.1.4 Change the period to a semi-colon and add the word "*or*" to this Clause.

14.2.1.5 Add a new Clause as follows:

*fails to achieve Substantial Completion of the Project within the time limits established by the Contract Documents.*

14.2.2 Change the word "*Architect*" to "*Prime Professional*" and change the words "*certification by*" to "*advice of*".

14.2.4 Change the word "*Architect's*" to "*Prime Professional's*".

## Article 15
## CLAIMS AND DISPUTES

15.1 **Claims**

15.1.2 Change this Subparagraph to read as follows:

***Commencement of Statutory Limitation Period***
*The Owner and Contractor shall commence all claims and causes of action within the time period specified by applicable state law.*

15.1.3.1 Change each instance of the word "*Architect*" to "*Prime Professional*".

15.1.4 Change this Subparagraph to read as follows:

*Where both the Owner and the Contractor concur with the Initial Decision Maker's decision, the Contract Sum and Contract Time shall be adjusted in accordance with Article 7 and the Prime Professional will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.*

15.1.7 Delete this Subparagraph in its entirety.

15.2 **Initial Decision**

15.2.1 Change this Subparagraph to read as follows:

*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 and 10.4, shall be referred to the Initial Decision Maker for initial decision. The Prime Professional will serve as the Initial Decision Maker. An initial decision by the Initial Decision Maker shall be required as a condition precedent to arbitration or litigation of all Claims between the Contractor and Owner arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered by the Initial Decision Maker. The Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.*

15.2.2 Change the words "*approve the Claim*" to "*recommend approval of the Claim to the Owner*".

15.2.4 Change the words "*reject or approve the Claim*" to "*recommend rejection or approval of the Claim to the Owner*".

15.2.5 Change the Subparagraph to read as follows:

*The Initial Decision Maker will render an initial decision to recommend approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision recommendation shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Prime Professional, if the Prime Professional is not serving as the Initial Decision Maker, of any recommended change in the Contract Sum or Contract Time or both. Where the Owner concurs with the recommendation it is binding on the parties but subject to arbitration or litigation.*

15.2.6 Delete this Subparagraph in its entirety.

15.2..6.1 Delete this Clause in its entirety.

15.3 **Mediation**

15.3.1 Delete this Subparagraph in its entirety.

15.3.2 Delete this Subparagraph in its entirety.

15.3.3 Delete this Subparagraph in its entirety.

15.4 **Arbitration**

15.4.1 Delete this Subparagraph in its entirety.

15.4.1.1 Delete this Clause in its entirety.

15.4.2 Delete this Subparagraph in its entirety.

15.4.3 Delete this Subparagraph in its entirety.

15.4.4 Delete this Subparagraph in its entirety.

15.4.4.1 Delete this Clause in its entirety.

15.4.4.2 Delete this Clause in its entirety.

15.4.4.3 Delete this Clause in its entirety.

15.5 Add a new Paragraph as follows:

***Arbitration Procedures for the Department of Finance and Administration's Bureau of Building, Grounds and Real Property Management***

*All matters of dispute arising out of any agreement with the Department of Finance and Administration for planning, design, engineering, construction, erection, repair, or alteration of any building, structure, fixture, road, highway, utility or any part thereof, or any agreement with the Department of Finance and Administration for architectural, engineering, surveying, planning, and related professional services which provides for mediation or arbitration, shall comply with the following course for resolution. No arbitration hearing shall be granted on any claim in excess of One Hundred Thousand Dollars ($100,000.00).*

15.5.1 Add a new Subparagraph and Clauses as follows:

***Conditions Precedent to Arbitration***

*.1 The aggrieved party must first notify opposing party in writing in detail of the matter(s) in dispute the amount involved and the remedy sought. Such writing shall include copies of any documents, writings, plans, or other matter pertinent to the resolution of the dispute. The Director of the Bureau of Building and a principal of the opposing party shall be the proper parties for such notice and shall be active parties in any subsequent dispute resolution.*

*.2 If the dispute cannot be satisfactorily resolved, within thirty (30) days of the complaint being rejected in writing by either party, notice by certified mail shall be given to the Deputy Director of the Department of Finance and Administration. A copy of the notice shall be sent by certified mail to the opposing party. Such notice shall be in writing setting forth in detail the matter(s) in dispute, the amount involved, the remedy sought and state that informal resolution between the parties cannot be reached. Such writing shall include copies of any documents, writings, plans, or other matter pertinent to the resolution of the dispute. Opposing party shall have the opportunity to set forth in writing a rebuttal with pertinent documents attached. At the sole discretion of the Deputy Director, oral testimony may be had on the matter.*

15.5.2 Add a new Subparagraph as follows:

***Requests for Arbitration***

*Within thirty (30) days of a claim being rejected in writing by the Deputy Director of the Department of Finance and Administration, either party may request arbitration. Notices for requests for arbitration shall be made in writing to the Executive Director of the Department of Finance and Administration, P.O. Box 267, Jackson, MS 39201. Such notice shall set forth in detail the matter(s) in dispute, the amount involved, and the remedy sought. A copy of the request shall be mailed to the opposite party. The party requesting arbitration must deposit the sum of two hundred ($200.00) with its request as a deposit against costs incurred by the arbitrators. Each party will be notified in writing in any manner provided by law of certified mail not less than twenty (20) days before the hearing of the date, time and place for the hearing. Appearance at the hearing waives a party's right to notice.*

15.5.3 Add a new Subparagraph as follows:

***Selection of Arbitrators***

*Upon request for arbitration, a panel of three (3) arbitrators shall be chosen. One (1) member shall be appointed by the Executive Director of the Department of Finance and Administration. One (1) member shall be appointed by the executive director of a professional or trade association which represents interests similar to that of the non-state party. The third member shall be appointed by the first two.*

15.5.4 Add a new Subparagraph as follows:

***Hearings***

*All hearings shall be open to the public. All hearings will be held in Jackson, Mississippi, unless another location is mutually agreed to by the parties. The hearings shall be conducted as prescribed by* ***Mississippi Code 1972, Annotated****, Sections 11-15-113, 11-15-115, and 11-15-117. A full and complete record of all proceedings shall be taken by a certified court reporter. The scheduling and cost of retaining the court reporter shall be the responsibility of the party requesting arbitration. The costs of transcription of the record shall be the responsibility of the party requesting such transcript. No arbitration hearing shall be held without a certified court reporter. Deliberations of the arbitrators shall not be part of the record.*

15.5.5 Add a new Subparagraph as follows:

***Awards***

*Awards shall be made in writing and signed by the arbitrators joining in the award. A copy of the award shall be delivered to the parties by certified mail.*

15.5.6 Add a new Subparagraph as follows:

***Fees and Expenses***

*Reasonable fees and expenses, excluding counsel fees, incurred in the conduct of the arbitration shall be at the discretion of the Arbitrator except each party shall bear its own attorney's fees and costs of expert witnesses.*

15.5.7 Add a new Subparagraph as follows:

***Modifications, Confirmations, and Appeals***

*All modifications, confirmations and appeals shall be as prescribed by* ***Mississippi Code 1972, Annotated****, Section 11-15-123 et seq. All awards shall be reduced to judgment and satisfied in the same manner other judgments against the State are*

*satisfied.*

15.5.8 Add a new Subparagraph as follows:

***Secretary for the Arbitrators***

*All notices, requests, or other correspondence intended for the arbitrators shall be sent to Executive Director, Department of Finance and Administration, P.O. Box 267, Jackson, MS 39201.*

# MINORITY PARTICIPATION
## SECTION 00 7339

### PART 1 – PARTICIPATION FORM

1.01 **GENERAL**

The Contractor will submit the following form within seven (7) days from the Notice to Proceed:

Department of Finance and Administration
Bureau of Building, Grounds and Real Property Management
**501 NORTH WEST STREET, SUITE 1401 B • JACKSON, MISSISSIPPI 39201**
**TEL (601) 359-3621 • FAX (601) 359-2470**

Minority Tracking or Participation Form
February 2003

This document will serve as a tracking instrument for minority participation in publicly funded construction projects managed by the Bureau of Building, Grounds and Real Property Management. This document will aid DFA/BOB in its commitment to encourage minority participation during the bidding process. Your conscientious effort and commitment to help establish good business relations with minority subcontractors, consultants, suppliers, partners and/or joint ventures is greatly appreciated.

Any responses will be deemed public information and may be incorporated into reporting information compiled by the Bureau of Building in the following manner: Contractors that listed minority participation, Contractors that did not list minority participation and Contractors that submitted an incomplete (partially filled-out or blank) form.

The Prime General Contractor will submit to the Owner within seven (7) days from the Notice to Proceed, a completed *Minority Tracking Form* (as follows) outlining the use of minority subcontractors that will be used on the project.

Minority - A person who is a citizen or lawful permanent resident of the United States and who is the following:
**African American, Hispanic American, Asian American, American Indian or Female**

Project Name and Number: _____

General Contractor: (Name) _____

**Check the Following Appropriate Box**

☐ **There are NO minority participants included in this bid proposal.**

☐ **There are minority participants included in this bid proposal.** The minority participants may be defined as: Subcontractor(s)/Consultant(s)/ Supplier(s) / Partner(s) / Joint Ventures(s).

List minority participants and their discipline/responsibility per the above or per Construction Specification Institution (CSI) forty-eight (48) divisions.

Name: _____

Division: _____

Amount $ _____

Name: _____

Division: _____

Amount $ _____

Name: _____

Division: _____

Amount $ _____

Name: _____

Division: _____

Amount $ _____

Name: _____

Division: _____

Amount $ _____

Name: _____

Division: _____

Amount $ _____

Name: _____

Division: _____

Amount $ _____

Name: _____

Division: _____

Amount $ _____

Name: _____

Division: _____

Amount $ _____

Name: _____

Division: _____

Amount $ _____

**Division 0**

Name: _____

Division: _____

Amount $ _____

Name: _____

Division: _____

Amount $ _____

Name: _____

Division: _____

Amount $ _____

**End of Form**

# LABOR REQUIREMENTS
## SECTION 00 7343

### PART 1 - EQUAL OPPORTUNITY

1.01 **GENERAL**

The Contractor will maintain policies of employment as follows:

A. The Contractor and all Subcontractors will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin or age. The Contractor will take affirmative action to insure that applicants are employed and that employees are treated during employment without regard to their race, religion, color, sex, national origin, or age. Such action will include, but not be limited to the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

B. The Contractor and all Subcontractors will, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants receive consideration for employment without regard to race, religion, color, sex, national origin or age.

### PART 2 – FEDERAL REQUIREMENTS

2.01 **APPLICABILITY**

When project funding includes Federal funds, the applicable Federal Labor Standards Provisions will be included herein, to which the Contractor, and all Subcontractors, shall be subject to. Where no such pages are included, then no special provisions shall apply.

### PART 3 - WAGE RATES

3.01 **GENERAL**

When project funding includes Federal funds, the applicable Federal Government Wage Determinations will be included herein, to which the Contractor, and all Subcontractors, shall be subject to. Where no such pages are included, then no special wages shall apply.

# SPECIAL CONDITIONS
## SECTION 00 8000

**PART 1 - PERFORMANCE INFORMATION**

**N/A**

**PART 2 – GRANT CONDITIONS**

**N/A**

**PART 3 – OTHER CONDITIONS**

**N/A**

# ADDENDA
## SECTION 00 9000

1.01 **ADDENDA**

Any Addendum issued on this Project will be included in Section 00 9000 and become a part of the *Standard Form of Agreement Between the Owner and Contractor*.

# SUMMARY OF WORK
## SECTION 01 1000

1.01 **WORK COVERED BY CONTRACT DOCUMENTS**

A. **Work Covered**: Work covered by the Contract Documents is as shown in drawings and described in words in the Project Manual. The Project Title and location is indicated on the first page of this Project Manual.

B. **Start of Work**: Work shall be started immediately upon issuance of a *Notice to Proceed*. Prior to this, all Contracts and beginning documents will have been executed and insurance in force.

C. **Time of Completion**: The completion of this Work is to be on, or before, the time indicated in the *Standard Form of Agreement Between the Owner and the Contractor*.

D. **Contractor's Duties**:

1. Except as specifically noted, provide and pay for:
   a. Labor, materials and equipment.
   b. Tools, construction equipment and machinery.
   c. Water, heat and utilities required for construction.
   d. Other facilities and services necessary for proper execution and completion of the Work.
2. Pay legally required sales, consumer, use, payroll, privilege and other taxes.
3. Secure and pay for, as necessary for proper execution and completion of work, and as applicable at the time of the receipt of the bids:
   a. Permits.
   b. Government fees.
   c. Licenses.
4. Give required notices.
5. Comply with codes, ordinances, rules, regulations, orders and other legal requirements of public authorities which bear on performance of work.
6. Promptly submit written notice to Professional of observed variance of Contract Documents from legal requirements. It is not the Contractor's responsibility to make certain that drawings and specifications comply with codes and regulations. Appropriate modifications to Contract Documents will adjust necessary changes. Assume responsibility for work known to be contrary to such requirements, without notice.
7. Enforce strict discipline and good order among employees. Do not employ or work unfit persons, or persons, not skilled in assigned task.
8. Provide a written safety plan.

E. **Hazardous Materials**: The Prime General Contractor is responsible for the removal and disposal of any hazardous materials encountered in the performance of the Contract requirements. Hazardous Containing Materials [HCM] include, but are not limited to, Asbestos and Lead Paint and should be identified and removed as a part of the Contract. The absence of details does not relieve the Prime General Contractor from the responsibility of removal and disposal; but, a Change Order could be executed in the absence of identified HCM in the documents.

F. **Coordination**: The Prime General Contractor is responsible for the coordination of the total project. All other Contractors and all Subcontractors will cooperate with the Prime General Contractor so as to facilitate the general progress of the Work. Each trade shall afford all other trades every reasonable opportunity for the installation of their work. Refer to Section 01 3100 entitled *Project Coordination*.

1.02 **CONTRACTS**

**Contracts**: Construct work under a single Prime General Contract. Refer to Section 00 5200 entitled *Standard Form of Agreement Between the Owner and the Contractor*.

1.03 **WORK BY OTHERS**

Work by Others shall be described in each appropriate Project Manual section and noted on the Drawings.

1.04 **OWNER-FURNISHED PRODUCTS**

A. **Products Furnished By Owner**: Products furnished by Owner shall be described in each appropriate Project Manual section and noted on the Drawings.

B. **Products**: Delivered and unloaded at site.

C. **Owner's Duties**:
1. Schedule delivery date with Supplier in accordance with construction schedule.
2. Obtain installation drawings and instructions.
3. Submit claims for transportation damages.
4. Arrange Guarantees, Warranties, etc..

D. **Contractor's Duties**:
1. Designate required delivery date for each product in construction schedule.
2. Promptly inspect delivered products, report missing, damaged, or defective items.
3. Handle at site, including uncrating and storage.
4. Protect from exposure to elements and from damage.
5. Repair or replace damaged items resulting from Contractor's operations.
6. Install and make final connections.

1.05 **CONTRACTOR'S USE OF PREMISES**

A. Confine operations at site to areas permitted by:
1. Law.
2. Ordinances.
3. Permits.
4. Contract Documents.
5. Owner.

B. Do not unreasonably encumber site with materials or equipment.

C. Do not load structure with weight that will endanger structure.

D. Assume full responsibility for protection and safekeeping of products stored on premises.

E. Move any stored products which interfere with operations of Owner or other Contractors.

F. Obtain and pay for use of additional storage or work areas needed for operations.

G. Limit use of site for work and storage to the area indicated in the drawings.

1.06 **SPECIAL REQUIREMENTS**

A. Refer to Section 01 8000 entitled *Special Requirements* for any Project specific summary of work requirements.

# ALLOWANCES
## SECTION 01 2100

1.01 **DESCRIPTION**

A. **Related Work Specified Elsewhere**: Sections of Specifications as listed under Schedule of Allowances.

B. **Allowances for Products**:
1. Purchase products under each allowance as directed by the Professional.
2. Amount of each allowance includes:
   a. Net cost of product.
   b. Delivery and unloading at site.
   c. Applicable taxes.
3. In addition to amounts of allowances, include in bid, for inclusion in Contract Sum, Contractor's costs for:
   a. Handling at site, including uncrating and storage.
   b. Protection from elements and damage.
   c. Labor, installation and finishing.
   d. Other expenses required to complete installation.
   e. Overhead and profit.

C. **Selection of Products**:
1. **Architect's Duties**: Consult with Contractor in consideration of products and Suppliers; make selections, designate products to be used; and, notify Contractor in writing.
2. **Contractor's Duties**: Assist Professional in determining qualified Suppliers; obtain proposals from Suppliers when requested by the Professional; and, make appropriate recommendations for consideration of the Professional. Upon notification of selection, enter into Purchase Agreement with designated Supplier.

D. **Delivery**: The Contractor is responsible for arranging all delivery and unloading and should promptly inspect products for damage or defects and submit claims for transportation damage.

E. **Installation**: Comply with requirements of referenced specification section.

F. **Adjustment of Costs**: Should actual purchase cost be more, or less, than the specified allowance amount, the Contract Sum will be adjusted by Change Order equal to the amount of the difference.

1.02 **SCHEDULE OF ALLOWANCES**

A. Refer to Section 01 8000 entitled *Special Requirements* for Project specific Schedule of Allowances.

# ALTERNATES
## SECTION 01 2300

1.01 **DESCRIPTION**

A. **Scope**: This section describes the changes to be made under each alternate.

B. **General**: The referenced Specification sections contain the pertinent requirements for materials and methods to achieve the work described herein. Coordinate related work and modify surrounding work, as required, to complete the Project under each alternate designated in the Contract.

1.02 **DESCRIPTION OF ALTERNATES**

A. Refer to Section 01 8000 entitled *Special Requirements* for Project specific description of project Alternates.

# CHANGE ORDER PROCEDURES
## SECTION 01 2600

1.01 **SCOPE**

A. This Section describes the procedures for processing Change Orders to the Contract by the Owner, the Professional and the Contractor.

1.02 **CHANGE ORDER PROCEDURES**

A. **Change Proposed by Professional**: The Professional may issue a Change Order Request to the Contractor which includes a detailed description of a proposed change with supplementary or revised Drawings and Specifications and a change in Contract Time for executing the change. The Contractor will prepare and submit a Change Order Proposal within ten (10) working days.

B. **Change Proposed by Contractor**: The Contractor may propose a change by submitting a request for change to the Professional, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other Contractors. Document any requested substitutions in accordance with Section 01 6000 entitled *Substitutions and Product Options*.

C. **Contractor's Documentation**:
1. Maintain detailed records of Work completed on a time and material basis. Provide full information required for evaluation of proposed changes, and substantiate costs of changes in the Work.
2. Document each quotation for a change in cost or time with sufficient data allowing evaluation of the quotation.
3. On request, provide additional data to support computations:
   a. Quantities of products, labor, and equipment
   b. Taxes, insurance and bonds
   c. Overhead and profit
   d. Justification for any change in Contract Time
   e. Credit for deletions from Contract, similarly documented
4. Support each claim for additional costs, and for Work completed on a time and material basis, with additional information:
   a. Origin and date of claim
   b. Dates and times work was performed and by whom
   c. Time records and wage rates paid
   d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

D. **Construction Change Directive**: The Professional may issue a document, approved by the Owner, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. The document will describe changes in the Work, and will designate method of determining any change in Contract Sum or Contract Time. The change in Work will be promptly executed.

E. **Format**: The Professional will prepare three (3) originals of the Change Order or Change Directive using the Bureau of Building, Grounds and Real Property Management's *Change Order Form*. Where time is of the essence, and at the sole discretion of the Owner, scanned documents may be deemed acceptable to the Owner where signatures and dates are executed in blue ink.

F. **Types of Change Orders**:
1. **Stipulated Sum Change Order**: Based on Proposal Request and Contractor's fixed price quotation, or Contractor's request for a Change Order as approved by the Professional.
2. **Unit Price Change Order**: For pre-determined unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units of work which are not pre-determined, execute Work under a Construction Change Directive. Changes in Contract Sum or Contract

Time will be computed as specified for Time and Material Change Order.

3. **Time and Material Change Order**: Submit itemized account and supporting data after completion of change, within time limits indicated in the *Standard Form of Agreement Between the Owner and the Contractor*. The Professional will determine the change allowable in Contract Sum and Contract Time as provided in the Contract Documents. The Contractor shall maintain detailed records of Work accomplished on Time and Material basis and shall provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.

G. **Execution of Change Order**: The Professional will issue Change Orders for signatures of parties as provided in the *Standard Form of Agreement Between the Owner and the Contractor*. Final execution of all Change Orders requires approval by the Owner.

H. **Correlation of Contractor Submittals**: The Contract shall promptly revise *Schedule of Values* and the *Application for Payment* forms to record each authorized Change Order as a separate line item and adjust the Contract Sum. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust time for other items of Work affected by the change and resubmit. Promptly enter changes in Project Record Documents.

# SCHEDULE OF VALUES
## SECTION 01 2973

1.01 **DESCRIPTION**

A. **Scope**: Submit a *Schedule of Values* to the Professional at least ten (10) days prior to submitting the first Application for Payment. Upon the Professional's request, the Contractor will provide supportive data substantiating their correctness. Use *Schedule of Values* only as basis for Contractor's Application for Payment.

B. **Form of Submittal**: Submit Schedule of Values on AIA Document G703, or computer generated form containing similar style, using Table of Contents of these Specifications as basis for format for listing costs of work for sections under Divisions 2-48. Identify each line item with number and title as listed in Table of Contents in these Specifications.

D. **Preparing Schedule of Values**:

1. Itemize separate line item cost for each of the following general cost items: Performance and Payment Bonds, field supervision and layout, temporary facilities and controls.
2. Itemize separate line item cost for work required by each Section of these Specifications. Break down installed cost with overhead and profit.
3. Where determined to be feasible by the Owner, for each line item which has installed value of more than $20,000, break down costs into sub-components or divisions of $20,000 or less, rounding figures to nearest dollar. Make sum of total costs of all items listed in Schedule equal to total Contract Sum.

E. **Preparing Schedule of Unit Material Values**:

1. Submit separate Schedule of unit prices for materials to be stored on which progress payments will be made. Make form of submittal parallel to Schedule of Values with each line item identified same as line item in Schedule of Values. Include in unit prices only: cost of material, delivery, unloading at site, and sales tax.
2. Make sure unit prices multiplied by quantities equal material cost of that item in Schedule of Values.

F. **Review and Resubmittal**: After Professional's review, if requested, revise and resubmit Schedule of Values in same manner.

# APPLICATIONS FOR PAYMENT
## SECTION 01 2976

1.01 **SCOPE**

A. This Section describes procedures for preparing and submitting Applications for Payment by the Contractor.

1.02 **APPLICATIONS FOR PAYMENT**

A. **Format**:
1. Applications for Payments will be prepared on AIA forms G702 - *Application and Certificate for Payment* and G703 - *Continuation Sheet*; or, a computer generated form containing similar data may be used.

B. **Preparation of Application**:
1. Present required information in typewritten form
2. Execute certification by signature of authorized officer
3. Use data from approved *Schedule of Values*. Provide dollar value in each column for each line item for portion of Work performed and for stored products.
4. List each authorized Change Order as an extension on continuation sheet, listing Change Order number and dollar amount as for an original Item of Work.
5. Prepare Application for Final Payment as specified in Section 01 7700 entitled *Contract Closeout.*

C. **Submittal Procedures**:
1. Submit original and one (1) copy of each Application for Payment
2. Submit an updated construction schedule with each Application for Payment as described in Section 01 3216 entitled *Progress Schedule* or Section 01 3127 entitled *Network Analysis Schedules*.
3. Submit requests for payment at intervals agreed upon by the Professional, Owner and Contractor.
4. Submit requests to the Professional at agreed upon times, or as may be directed otherwise.

D. **Substantiating Data**:
1. Submit data justifying dollar amounts in question when such information is needed.
2. Provide one (1) copy of the data with a cover letter for each submittal.
3. Indicate the Application number, date and line item number and description.

# PROJECT COORDINATION
## SECTION 01 3100

1.01 **DESCRIPTION**

A. **Scope**: To set forth procedures, conditions and responsibility for coordination of the total project.

B. **Project Coordinator**: The Contractor, as soon as practicable after the award of each Job Order, and prior to commencement of any on-site Work, shall submit name(s) and qualifications of the proposed superintendent and any assistant superintendents as set forth in the Contract Documents. Upon the approval of the Professional and the Owner, the Project Coordinator will remain until the Project is completed and cannot be removed during construction without the written consent of the Owner and the Professional.

C. **Project Manager**: Where a Project involves a Mississippi Landmark or a building and/or site potentially eligible for such designation, the Contractor shall also submit name and qualifications of the project home office project manager as set forth in the General and Supplementary Conditions of the Contract. Upon the approval of the Professional and the Owner, the Project Coordinator will remain until the Project is completed and cannot be removed during construction without the written consent of the Owner and the Professional.

1.02 **DUTIES OF PROJECT COORDINATOR**

A. **General**:
1. **Coordination**: Coordinate the work of all Subcontractors and Material Suppliers.
2. **Supervision**: Supervise the activities of every phase of work taking place on the Project.
3. **Mechanical/Electrical**: Take special care to coordinate and supervise the work of the plumbing, heating and cooling and electrical Subcontractors.
4. **Communication**: Establish lines of authority and communication at the job site.
5. **Location**: The Project Coordinator must be present on the job all of the time.
6. **Permits**: Assist in obtaining building and special permits required for construction.

B. **Interpretations of Contract Documents**:
1. **Consultation**: Consult with Architects and Engineers to obtain interpretations.
2. **Assistance**: Assist in resolution of any questions.
3. **Transmission**: Transmit written interpretations to concerned parties.

C. **Cessation of Work**: Stop all work not in accordance with the requirements of the Contract Documents.

D. **Division One**: Coordinate and assist in the preparation of all requirements of Division One and specifically as follows:
1. **Cutting and Patching**: Supervise and control all cutting and patching of other trades' work.
2. **Project Meetings**: Schedule and preside at all project meetings.
3. **Construction Schedules**: Prepare and submit all construction schedules; supervise work to monitor compliance with schedules.
4. **Shop Drawings, Product Data and Samples**: Administer the processing of all submittals required by the Project Manual.
5. **Schedule of Values**: Assist in preparation and be knowledgeable of each entry in the Schedule of Values.
6. **Testing**: Coordinate all required testing.
7. **Temporary Facilities and Controls**: Allocate, maintain and monitor all temporary facilities.
8. **Substitutions and Product Options**: Administer the processing of all substitutions.
9. **Project Closeout**: Conduct final inspections and assist in collection and preparation of closeout documents.
10. **Cleaning**: Direct and execute a continuing cleaning program throughout construction, requiring each trade to dispose their own debris.
11. **Project Record Documents**: Maintain up-to-date project record documents.
12. **Safety Measures**: Plan and enforce all safety requirements.

E. **Changes**: Recommend and assist in the preparation of requests to the Professional for any changes in the Contract.

F. **Application for Payment**: Assist in the preparation and be knowledgeable of each entry in the Application and Certificate for Payment.

1.03 **SUBCONTRACTOR'S DUTIES**

A. **General**: The Subcontractor is responsible for coordinating and supervising employees in the work to be accomplished under their part of the Contract.

B. **Schedules**: Conduct work to assure compliance with construction schedules.

C. **Suppliers**: Transmit all instructions to Material Suppliers.

D. **Cooperation**: Cooperate with the Project Coordinator and other Subcontractors.

1.04 **OWNER-PURCHASED PRODUCTS**

A. **General**: Cooperate, accept delivery, arrange storage and protect Owner-purchased products until installation, or final acceptance.

# PROJECT MEETINGS
## SECTION 01 3119

1.01 **DESCRIPTION**

A. **Contractor's Responsibilities**: The General Contractor will administer all progress meetings which include the following:
1. Prepare agenda
2. Distribute written notice of meetings to listed attendees seven (7) days in advance
3. Make physical arrangements for and presiding at the meetings
4. Record minutes
5. Distribute copies of the minutes to listed attendees, regardless of actual participation, within four (4) days

B. **Pre-Construction Meeting**: The Bureau will schedule a pre-construction meeting as soon as possible after the award of Contract and the issuance of a *Notice to Proceed*.
1. **Attendees**:
   a. Owner
   b. Professional and Consultants
   c. General Contractor
   d. Major Subcontractors, including mechanical and electrical
   e. Representatives of governmental, or other regulatory agencies
   f. Commissioning Authority Professional (if Cx on project)
2. **Minimum Agenda**: (prepared by the General Contractor)
   a. Distribute and discuss preliminary construction schedule
   b. Critical work sequencing
   c. Designation of responsible personnel
   d. Procedures for maintaining record documents
   e. Use of premises, including office and storage areas
   f. Owner's requirements
   g. Security procedures
   h. Housekeeping procedures
   i. Commissioning issues (if Cx on project)
3. **Utilities**: A written agreement must be reached on how all utilities will be furnished and the rates the Contractor will be charged. This agreement should be resolved at this meeting. Refer to Section 01 5000 entitled *Construction Facilities and Temporary Controls* and Section 01 8000 entitled *Special Requirements* of this Project Manual for additional utility requirements.

C. **Progress Meetings**:
1. The Bureau will schedule regular meetings at the time of the pre-construction conference
2. Hold all meetings as progress of work dictates
3. **Attendees**:
   a. Owner
   b. Professional and Consultants
   c. General Contractor
   d. Subcontractors, as pertinent to the agenda
   e. Commissioning Authority Professional (if Cx on project)
4. **Minimum Agenda**:
   a. Review, approve minutes of the previous meeting
   b. Review work progress since last meeting
   c. Note field inspections, problems and decisions
   d. Identify problems which impede planned progress
   e. Review off-site fabrication problems
   f. Revise construction schedule, as indicated
   g. Plan progress during the next work period
   h. Review proposed changes

i. Complete other current business
j. Commissioning issues (if Cx on project)

D. **Commissioning Meetings (if Cx on project)**:

1. The Bureau will schedule a commissioning scoping meeting the pre-construction conference. Regular Commissioning Meetings will coincide with regularly scheduled Progress Meetings until such time that the Commissioning Process requires additional meetings. The Commissioning Authority Professional will chair, facilitate and document all Commissioning Meetings.
2. **Attendees:**
    a. Owner
    b. Commissioning Authority Professional
    c. Professional and Consultants
    d. General Contractor
    e. Subcontractors, as pertinent to unresolved issues identified in current Issues Log
    f. Testing, Adjusting and Balancing Contractor
    g. Using Agency's Building Operator/Physical Plant Representative
3. **Minimum Agenda:**
    a. Review, approve minutes of the previous meeting
    b. Review Issues Log

# PROGRESS SCHEDULES
## SECTION 01 3216

1.01 **DESCRIPTION**

A. **Scope**: Provide projected construction schedules for the entire Work and revise periodically. The following is a minimum requirement and other type schedules are acceptable with Owner's approval. This type of schedule is acceptable for any Project whose initial Contract award amount is **less than** one (1) million dollars ($1,000,000).

B. **Form of Schedules**: Prepare in form of horizontal bar chart.

1. Provide separate horizontal bar column for each trade or operation.
2. Place in order of the Table of Contents of Specifications.
3. Identify each column by major Specification section number.
4. Identify the first work day of each week by horizontal time scale.
5. Scale and space to allow for updating.

C. **Contents of Schedule**:

1. Provide complete sequence of construction by activity.
2. Indicate dates for beginning and completion of each stage of construction.
3. Identify work of separate floors, separate phases, or other logically grouped activities.
4. Show projected percentage of completion for each item of work as of first day of month.

D. **Updating**:

1. Show all changes occurring since previous submission of updated schedule.
2. Indicate progress of each activity and completion dates.

E. **Submittals**:

1. Submit initial schedules to the Professional within fifteen (15) days after date of *Notice to Proceed*.
2. Submit to Professional periodically updated schedules accurately depicting progress to first day of each month.
3. Submit two (2) copies, one (1) to be retained by the Professional and the other forwarded to the Owner.

# NETWORK ANALYSIS SCHEDULE
## SECTION 01 3217

1.01 **DESCRIPTION**

A. **Scope**: Provide projected network analysis schedules for the entire Work and revise periodically. This type of schedule is acceptable for any Project whose initial Contract award amount is one million dollars ($1,000,000), **or greater**.

1.02 **REFERENCES**

A. **Critical Path Methods in Construction Practice, 4th Edition:** Written by James M. Antill and Ronald W. Woodhead, published by Wiley.

1.03 **QUALITY ASSURANCE**

A. **Contractor's Administrative Personnel**: Two (2) years minimum experience in using and monitoring CPM schedules on comparable Projects is required.

1.04 **FORMAT**

A. **Listings**: Reading from left to right, in ascending order for each activity, identify each activity with the applicable specification section number.

B. **Diagram Sheet Size**: Height and width as required.

C. **Scale and Spacing**: To allow for notations and revisions.

1.05 **SCHEDULES**

A. **Critical Path Methods**: Prepare network analysis diagrams and supporting mathematical analyses using the critical path method.

B. **Order of Work**: Illustrate order and interdependence of activities and sequence of Work; how start of a given activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.

C. **Complete Sequence of Construction**: Illustrate complete sequence of construction by activity, identifying work of separate stages. Provide dates for submittals and return of submittals; dates for procurement and delivery of products; and dates for installation and provision for testing. Provide legend for symbols and abbreviations used.

D. **Mathematical Analysis**: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
1. Preceding and following event numbers
2. Activity description
3. Estimated duration of activity, in maximum thirty (30) day intervals
4. Earliest start date
5. Earliest finish date
6. Actual start date
7. Actual finish date
8. Latest start date
9. Latest finish date
10. Total and free float
11. Monetary value of activity (keyed to *Schedule of Values*)

12 Percentage of activity completed
13. Responsibility

E. **Analysis Program**: Capable of compiling monetary value of completed and partially completed activities, of accepting revised completion dates, and re-computation of all dates and floats.

F. **Required Sorts**: List activities in sorts or groups:
1. By preceding work item or event number from lowest to highest
2. By amount of float, then in order of early start
3. By responsibility in order of earliest possible start date
4. In order of latest allowable start dates
5. In order of latest allowable finish dates
6. Contractor's periodic payment request sorted by *Schedule of Values* listings, Specifications section
7. Listing of basic input data which generates the report
8. Listing of activities on the critical path
9. Monthly cash flow

G. ***Schedule of Values***: Coordinate contents with *Schedule of Values* in Section 01 2973.

1.06 **SUBMITTALS FOR REVIEW**

A. **Preliminary Network Diagram**: Within fifteen (15) days after the date established in the *Notice to Proceed* submit proposed preliminary network diagram defining planned operations for the first sixty (60) days of Work, with a general outline for the remaining Work.

B. **Review**: Participate in review of preliminary and complete network diagrams jointly with the Professional.

C. **Proposed Complete Network Diagram**: Within twenty (20) days after joint review of proposed preliminary network diagram, submit draft of proposed complete network diagram for review. Include written certification that mechanical and electrical Subcontractors have reviewed and accepted proposed schedule.

D. **Complete Network Diagram**: Within ten (10) days after joint review, submit complete network analysis consisting of network diagrams and mathematical analysis.

E. **Updated Network Schedules**: Submit updated network schedules with each Application for Payment.

F. **Copies**: Submit the number of opaque reproductions the Contractor requires, plus two (2) copies which will be retained by the Professional and the Owner.

1.07 **REVIEW AND EVALUATION**

A. **Review**: Participate in joint review and evaluation of network diagrams and analysis with the Professional at each submittal.

B. **Evaluate**: Evaluate Project status to determine Work behind schedule and Work ahead of schedule.

C. **Revisions**: After review and approval of the Professional, revise as necessary as a result of the review and resubmit within ten (10) days.

1.08 **UPDATING SCHEDULES**

A. **Schedules**: Maintain schedules to record actual start and finish dates of completed activities.

B. **Progress**: Indicate progress of each activity to date of revision, with projected completion date of each activity. Update diagrams to graphically depict current status of Work.

C. **Modifications**: Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

D. **Changes**: Indicate changes required to maintain Date of Substantial or Total Completion. These changes will be made only with the approval of the Professional.

E. **Extensions**: Contract completion time will be adjusted only for causes specified in the Contract. Requests for an extension of the contract completion date by the Contractor shall be supported with a justification, CPM data and supporting evidence as the Owner may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the Contract. Submission of proof based on revised activity logic duration and costs is obligatory to any approvals. The schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved in the request. The Owner's determination as to the total number of days of contract extension shall be based upon the current computer-produced calendar-dated schedule for the time period in question and all other relevant information. Actual delays in activities which, according to the computer-produced calendar-dated schedule, do not affect the extended and predicted contract completion dates shown by the critical path in the network, will not be the basis for a change to the contract completion date. The Owner will, within a reasonable time after receipt of such justification and supporting evidence, review the facts and advise the Contractor in writing of the Owner's decision. The Contractor shall submit each request for a change in the contract completion date to the Owner. The Contractor shall include as a part of each change order proposal, a sketch showing all CPM revisions, duration changes, and cost changes, for the work in question and its relationship to other activities on the approved arrow diagram.

F. **Substantiate**: Submit sorts required to support recommended changes.

G. **Report**: Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

1.09 **DISTRIBUTION**

A. **Distribution of Copies**: Following joint review, distribute copies of updated schedules to Contractor's Project site, to Subcontractors, Suppliers, Professional and Owner.

B. **Reporting Problems**: Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

# SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
## SECTION 01 3323

1.01 **DESCRIPTION**

A. **Scope**: Submit to the Professional shop drawings, product data and samples required by Specification sections. Submit an additional copy of shop drawings, product data and samples related to items/systems identified to be commissioned to the Commissioning Authority Professional to be reviewed concurrently with the Professional. (if Cx on project).

B. **Shop Drawings**: Original drawings prepared by Contractor, Subcontractor, Supplier, or Distributor which illustrate some portion of the Work; showing fabrication, layout, setting, or erection details.
1. Prepared by a qualified detailer.
2. Identify details by reference to sheet and detail numbers shown on Contract drawings.
3. Minimum sheet size: 8 1/2" x 11"
4. Reproductions for submittals: Opaque diazo prints.

C. **Product Data**:
1. **Manufacturer's Standard Schematic Drawings**: Modify drawings to delete information which is not

applicable to the Project. Supplement standard information to provide additional information applicable to the Project.

2. **Manufacturer's Catalog Sheets, Brochures, Diagrams, Schedules, Performance Charts, Illustrations and Other Standard Descriptive Data**: Clearly mark each copy to identify pertinent materials, products, or models. Show dimensions and clearances required. Show performance characteristics and capacities, wiring diagrams and controls.

D. **Samples**: Physical examples to illustrate materials, equipment or workmanship and to establish standard by which completed work is judged.

1. **Office Samples**: Of sufficient size and quantity to clearly illustrate functional characteristics of products or material with integrally related parts and attachment devices and full range of color samples. After review, samples remain the property of the Professional until completion of the construction project.
2. **Field Samples and Mock-ups**: Erect on project site at location acceptable to Professional. Construct each sample, or mock-up, completely including work of all trades required in finished work.

E. **Contractor's Responsibilities**:

1. Review shop drawings, product data and samples prior to submission.
2. Verify field measurements, field construction criteria, catalog numbers and similar data.
3. Coordinate each submittal with requirements of work and of Contract Documents.
4. Contractor's responsibility for errors and omissions in submittals is not relieved by the Professional's review of submittals.
5. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved by Professional's review of submittals unless Professional gives written acceptance of specific deviations.
6. Notify Professional in writing at the time of submission of deviations in submittals from requirements of Contract Documents.
7. Begin no work requiring submittals until the return of submittals bearing Professional's stamp and initials, or signature indicating review.
8. After Professional's review, distribute copies.

F. **Submission Requirements**:

1. Schedule submission with ample time before dates reviewed submittals will be needed.
2. Submit number of copies of shop drawings and product data which Contractor requires for distribution, plus one (1) copy to be retained by the Professional.
3. Submit number of samples specified in each Specification section.
4. Accompany submittals with transmittal letter, in duplicate, containing date, Project title and number; Contractor's name and address; the number of each shop drawings, product data and samples submitted; notification of deviations from Contract Documents; and, other pertinent data.
5. Submittals shall include:
   a. Date and revision dates.
   b. Project title and number.
   c. The names of the Professional, Contractor, Supplier, Manufacturer and separate detailer, when pertinent.
   d. Identification of product, or material.
   e. Relation to adjacent structure, or materials.
   f. Field dimensions clearly identified as such.
   g. Specification section number.
   h. Applicable standards such as ASTM number, or federal specifications.
   i. A blank space (2" x 3") for the Professional's stamp.
   j. Identification of deviations from Contract Documents.
   k. Contractor's stamp, initialed or signed, certifying the review of submittal, verification of field measurements and compliance with Contract Documents.

G. **Resubmission Requirements**:

1. **Shop Drawings**: Revise initial drawings, as required, and resubmit as specified for initial submittal. Indicate on the drawings any changes which have been made other than those required by the Professional.

2. **Product Data and Samples**: Submit new data and samples, as required, for initial submittal.

H. **Distribution of Submittals After Review**:
1. Distribute copies of shop drawings and product data which carry Professional's stamp to Contractor's file, job site file, Subcontractor, Supplier and Fabricator.

2. Distribute samples as directed.

I. **Professional's Duties**:
1. Review submittals with reasonable promptness.
2. Review for design concept of Project and information given in Contract Documents.
3. Review of separate item does not constitute review of an assembly in which item functions.
4. Affix stamp and initials, or signature, certifying the review of submittal.
5. Return submittals to Contractor for distribution.

# TESTING LABORATORY SERVICES
## SECTION 01 4529

1.01 **DESCRIPTION**

A. **Scope**: The Contractor will employ and pay for the services of an independent laboratory to perform specified services. In some instances, Owner will provide such testing services through independent testing laboratory retained by the Professional. Employment of a testing laboratory or provision of such services by others shall in no way relieve the Contractor of his obligation to perform work in accordance with the Contract.

B. **Inspection, Sampling and Testing**: Refer to each individual specification section for specific inspection, sampling and testing requirements.

C. **Qualification of Laboratory**:
1. Meet the *Recommended Requirements for Independent Laboratory Qualification* published by the American Council of Independent Laboratories.
2. Meet the basic requirements of ASTM E 329-70, *Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction*.
3. Responsible Engineer: Perform all testing under the direct supervision of a registered Professional engineer employed full time by the testing laboratory.
4. Submittals: Submit a copy of the inspection report of the facilities made by materials reference laboratory of National Bureau of Standards of any deficiencies reported by the inspection.
5. Approval: The Professional must approve the testing laboratory.

D. **Laboratory's Duties**:
1. Upon notice, cooperate with the Professional and the Contractor to promptly provide qualified personnel. Perform specified inspections, sampling and testing of materials and methods of construction to ascertain compliance with requirements of Contract Documents. Promptly notify the Professional and the Contractor of irregularities or deficiencies of work observed during performance of services.
2. Reports of inspections and tests will include:
   a. Date issued
   b. Project title and number
   c. Testing laboratory's name and address
   d. Name and signature of inspector
   e. Date of inspection, or sampling
   f. Record of temperature and weather
   g. Date of test
   h. Identification of product and Specification section
   i. Location of Project
   j. Type of inspection, or test

k. Observations regarding compliance with Contract Documents

3. Prompt distribution of copies of the inspection reports and tests to:
   a. Owner
   b. Professional
   c. General Contractor
   d. Consulting Engineer, when pertinent
   e. Subcontractor, when pertinent

E. **Contractor's Responsibilities**:

1. Cooperate with laboratory personnel to provide access to work and to manufacturer's operation. Provide the laboratory with the required quantities of preliminary samples representative of materials to be tested and required quantities. When required, furnish copies of mill test reports. Furnish laboratory casual labor to obtain and handle samples at the site and to facilitate inspections and tests. Provide facilities for laboratory's exclusive use for storage and curing of test samples. Notify laboratory sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests.
2. Arrange and pay for additional samples and tests required for Contractor's convenience. When initial tests indicate work does not comply with Contract Documents, the Contractor may employ and pay for the services of a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing.

# CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS
## SECTION 01 5000

1.01 **DESCRIPTION**

A. **Scope**: Work required under this section consists of all temporary construction facilities, services and related items to complete the work indicated on the drawings and described in the Project Manual.

B. **Standards**:

1. Conform to or exceed all temporary construction requirements stated in the current edition of the **International Building Code** [Chapter entitled *Safeguards During Construction*].
2. Refer to Section 00 7200 entitled *General Conditions of the Contract For Construction, Article 10 Protection of Persons and Property* as amended by Section 00 7300 *Supplementary Conditions*.

C. **Materials**: All materials required by the Work of this section shall be as specified in the respective sections.

1.02 **FACILITIES AND CONTROLS**

A. **Access**: The Prime General Contractor shall provide an adequate access and/or roads to the site of the structure, if required for the prosecution of work; and, should also provide and maintain at least one (1) temporary, or permanent, access to each working elevation to be permanently occupied.

B. **Hoisting Facilities**: The Prime General Contractor shall be responsible for providing suitable capacity and hoisting facilities for all people and materials. The use of the hoisting facilities shall be by mutual agreement of the Prime General Contractor and the individual Contractor.

C. **Field Office and Sheds**: At all times, the Prime General Contractor shall provide and maintain an on-site office with telephone, which may also be used by Subcontractors, the Owner and the Professional. Office location will be approved by the Owner. Where no suitable available space within an existing building is specifically identified for such purposes in Section 01 8000 entitled *Special Requirements* or elsewhere in the Contract Documents, the Prime General Contractor shall provide a trailer with full utilities for such purpose throughout the Contract Time with space for both Contractor management personnel as well as for holding progress meetings. Each general and individual Contractor shall provide suitable watertight/dampproof sheds or containers to house their construction materials.

D. **Sanitation Facilities**: The Prime General Contractor is responsible for furnishing adequate temporary toilet facilities on the job site unless use of existing facilities on site is specifically permitted in Section 01 8000 entitled *Special Requirements* or elsewhere in the Contract Documents.

E. **Drinking Water**: The Prime General Contractor shall provide at all times sanitary drinking water facilities for all workmen on the job including ice, when required, and paper cups, etc.

F. **Fire Protection**: The Prime General Contractor shall provide general temporary fire protection except where the Work is within an existing building with operational permanent fire protection systems. Subcontractors will be responsible for their own. Where operational permanent fire protection systems exist, the Prime General Contractor and all Subcontractors shall take care not to damage such systems and take measures to prevent accidentally engaging such systems. Where the temporary disabling of any existing operational system is required for the performance of the Work, such shut-down shall be coordinated with the Owner.

G. **Storage**: The Prime General Contractor shall coordinate the allocation of storage areas to the various Subcontractors.

H. **Temporary Heating/Cooling/Dehumidification**: The Prime General Contractor shall provide heating, cooling, dehumidification, fuel and services, as necessary, to protect all work from dampness and cold or excessive heat and humidity until final acceptance. If in the late stages of the construction, mechanical and electrical installations will permit operation without damage to systems, and subject to the approval of the Professional and Owner, the mechanical and electrical facilities may be used to provide heating, cooling, dehumidification and ventilation in strict accordance with conditions established by the Professional and/or his Consultants. However, the Owner is saved harmless of any costs of operation, including the periodic replacement of filters, or responsibility as to acceptance of mechanical and/or electrical installations.

I. **Utilities**: The Prime General Contractor shall make arrangements for and furnish all water, gas, electricity (lighting and power) and other utilities necessary for construction purposes unless otherwise specified in Section 01 8000 entitled *Special Requirements* or elsewhere in the Contract Documents. Where any such utilities are to be furnished by the Institution or Agency, and such requirements are not detailed in Section 01 8000 or elsewhere in the Contract Documents, a written agreement must be reached on how any such utilities (water, gas, and electricity) will be furnished and the rates the Contractor will be charged by the Institution or Agency prior to initial use of any such utility. A copy of the final agreement signed by the Contractor and the Institution or Agency must be forwarded to the Owner. If the written agreement is not filed with the Owner, the Contractor and the Institution or Agency waives all rights as to the rates charged. The Owner will then determine all utility rates and assess the charges before final payment is rendered.

J. **Project Sign**: Where required in Section 01 8000 entitled *Special Requirements* or elsewhere in the Contract Documents, the Contractor shall furnish and erect on adequate supports and maintain one (1) neatly constructed sign identifying the names of the Project, Governor, Owner, Prime Professional, Contractor and Using Agency/Institution, and Governing Board as applicable. Sign shall also indicate the source(s) of funds for the project. The erection of additional signs depicting the names of the Contractor, Sub-Contractor, or Vendors is strictly prohibited. Unless a larger sign is otherwise detailed in the Contract Documents, such sign shall be as follows:

1. The Prime General Contractor will erect on adequate supports one (1) neatly constructed and painted or printed four foot by eight foot (4’ x 8’) plywood or equivalent panel conforming to the Owner’s Project Sign Template to be furnished with text, colors, and graphics specific to the Project.
2. No logos, graphics, custom fonts or similar are permitted for Prime Professional or Contractor names depicted on Project Sign.
3. The Prime General Contractor is responsible for maintaining the Project Sign until Final Acceptance of the Work or until Substantial Completion when authorized by the Owner. Any damage, including chipping, pealing or fading of text or images shall be promptly repaired or replaced.

# SUBSTITUTIONS AND PRODUCT OPTIONS
## SECTION 01 6000

1.01 DESCRIPTION

A. Scope: To set forth the procedure and conditions for substitutions and to give the product options available to the Contractor.

1.02 PRODUCTS LIST

A. Within thirty (30) days after the Contract has been signed, the Contractor will submit to the Professional five (5) copies of a complete list of all products proposed for installation.

B. Tabulate the list by Specification sections.

C. For products specified under reference standards, include with listing of each product:

1. Name and address of Manufacturer.
2. Trade name.
3. Model, or catalog designation.
4. Manufacturer's data.
5. Performance and test data.
6. Reference standards.

1.03 CONTRACTOR'S OPTIONS

A. For products specified only by reference standards or technical performance requirements, select any product meeting product standards by any Manufacturer.

B. For products specified by naming a minimum of three (3) products or Manufacturers, select any product and Manufacturer named. Equivalent products will always be accepted if equal in all consequential respects.

C. For product specified by naming one (1) or more products and/or Manufacturers, but indicating the option of selecting equivalent products by stating "or equal" after specified product and/or Manufacturer, select any product meeting specified reference standards or technical performance requirements as represented by the named products and/or Manufacturers.

D. For products specified by naming only one (1) product and/or Manufacturer as a “basis of design”, an equivalent product will always be accepted if it is equal in all consequential respects.

E. For products specified by naming only one (1) product and Manufacturer and stating no substitutions will be accepted, there is no option and no substitutions will be allowed. This option must have written approval by the Owner before bidding.

1.04 SUBSTITUTIONS

A. A product or construction method that varies from a product or construction method specified in one or more consequential characteristics, reference standards, or technical performance requirements shall be considered a substitution.

B. Professional will not consider requests for substitutions during bidding.

C. Within thirty (30) days after the Contact has been signed, the Professional will consider formal requests from the Contractor for substitution of products in place of those specified. Submit five (5) copies of the request for substitutions. Include in the request:

1. Narrative summarizing characteristics, reference standards, or technical performance requirements that product varies from and how the proposed product or construction method will meet or exceed project requirements
2. For products:
    a. Product identification including Manufacturer’s name and address.
    b. Manufacturer’s literature: Product description, performance and test data and reference standards.

c. Samples.
d. Name and address of similar projects on which product was used and date of installation.

3. For construction methods:
   a. Detailed description of proposed method.
   b. Drawings illustrating methods.
4. Agreement to pay for any additional professional costs if acceptance of substitution will require substantial revision of Contract Documents.
5. Data relating to any delays to the construction schedule if any will result from proposed substitution.
6. Accurate cost data on proposed substitution if any project cost increases are anticipated or any cost savings are being offered for proposed substitution.

D. In making request for substitution, Contractor represents:

1. Proposed product, or method, has been investigated and determined that it is equal or superior in all respects to that specified.
2. The same or better guarantee and/or warranty will be provided for substitutions for product or method specified.
3. Installation of accepted substitutions will be coordinated into the Work, making such changes required of work to be complete in all respects at no additional cost to the Owner.
4. All claims for additional costs related to substitution, including any delays to the construction schedule, which consequently become apparent will be waived.
5. Unless specifically identified in substitution submittal and such delay is specifically agreed to by Change Order to the Contract, substitution will not cause any delay to the construction schedule.
6. Proposed product, or method, will not result in any additional costs to the Owner.

E. Substitutions will not be considered if:

1. Indicated, or implied, on shop drawings or product data submittals without formal request submitted in accordance with this Section.
2. Acceptance will require substantial revision of Contract Documents unless compensation for such additional professional costs are paid by Contractor at no additional cost to the Owner.
3. In the Professional's judgment, the product, or material, is not equal.

# CUTTING AND PATCHING
## SECTION 01 7329

1.01 **GENERAL DESCRIPTION**

A. **Scope**: To set forth broad, general conditions covering cutting and patching that applies to everyone and everything on the job.

B. Execute cutting including excavating, fitting, or patching of work required to:
   1. Make several parts fit properly.
   2. Uncover work to provide for installation of ill-timed work.
   3. Remove and replace defective work.
   4. Remove and replace work not conforming to Contract requirements.
   5. Install specified work in existing construction.

C. In addition to Contract requirements, upon Professional's written instructions:
   1. Uncover work for observation of covered work.
   2. Remove samples of installed materials for testing.
   3. Remove work to provide alteration of existing work.

D. Do not cut or alter work of another Contractor without permission.

E. **Payment of Costs**: Costs caused by ill-timed, or defective work, or work not conforming to Contract Documents will be borne by party responsible for ill-timed, defective work, or non-conforming work.

1.02 **MATERIALS/PRODUCTS**

A. **Materials for Replacement or Work Removed**: Comply with Specifications for type of work to be accomplished.

1.03 **EXECUTION**

A. **Inspection**: Inspect existing conditions of work, including elements subject to movement, or damage during cutting and patching.

B. **Preparation Prior to Cutting**: Provide shoring, bracing and support, as required, to maintain structural integrity of the building. Provide protection for other portions of work and protection from the elements.

C. **Performance**:
1. Execute cutting and demolition by methods which prevent damage to other work and will provide surfaces to receive installation of repairs and new work.
2. Execute excavating and backfilling by methods which prevent damage to other work and prevent settlement.
3. Restore work which has been cut or removed; install new products to provide completed work in accordance with requirements of Contract Documents.
4. Refinish entire surfaces, as necessary, to provide an even finish. Refinish continuous surfaces to the nearest intersection and assemblies entirely.

# CLEANING
## SECTION 01 7400

1.01 **DESCRIPTION**

A. **Scope**: Maintain premises and public properties from accumulations of waste, debris and rubbish caused by operations. At completion of work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials and clean all sight-exposed surfaces; leave Project clean and ready for occupancy.

1.02 **PRODUCTS**

A. **Materials**: Use only cleaning materials recommended by Manufacturer of surface to be cleaned. Use cleaning materials only on surfaces recommended by the cleaning materials Manufacturer.

1.03 **EXECUTION**

A. **During Construction**: Execute cleaning to insure that building, grounds and public properties are maintained free from accumulations of waste materials and rubbish. Wet down dry materials and rubbish to lay dust and prevent blowing dust. At reasonable intervals during progress of work, clean site and public properties and dispose of waste materials, debris and rubbish. Remove waste materials, debris and rubbish from site and legally dispose of at public or private dumping areas off Owner's property. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until building is ready for substantial completion or occupancy. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights. Schedule cleaning operations so that dust or other contaminants resulting from cleaning process will not fall on wet or newly painted surfaces.

B. **Final Cleaning**: Employ experienced workmen, or professional cleaners, for final cleaning. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces and concealed spaces. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight-exposed finishes. Repair, patch and touch up marred surfaces to specified finish to match adjacent surfaces. Broom clean paved surfaces; rake clean other surfaces of grounds. Replace air conditioning filters, if units were operated during construction. Clean ducts, blowers and coils if air conditioning units were operated without filters during construction. Maintain cleaning until Project, or respective portions thereof, is occupied by Owner.

# STARTING OF SYSTEMS
## SECTION 01 7500

1.01 **GENERAL**

A. **Scope**: This Section describes the procedures for start up of all building equipment and systems including necessary demonstration and instructions.

1.02 **STARTING SYSTEMS**

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

B. Notify Professional and Owner seven (7) days prior to start-up of each system.

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

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

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

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

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

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

1.03 **DEMONSTRATION AND INSTRUCTIONS**

A. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of Substantial Completion.

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

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at designated location.

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

# CONTRACT CLOSEOUT
## SECTION 01 7700

1.01 **DESCRIPTION**

A. **Scope**: The work required in this Section consists of the final inspections and the submission of all closeout documents and related items to complete the Work indicated on the Drawings and described in the Project Manual.

1.02 **FINAL INSPECTIONS**

A. **Professional's Review**: The Contractor shall make written notice that the Work of a Job Order is ready for final inspection and acceptance by the Owner to the Professional; such notice to be given not less than ten (10) days prior to the date desired for inspection. The Professional will promptly visit the site and assess the state of Work of the Job Order to determine if it is ready for final inspection by the Owner. If, in the Professional's judgment, the Work of the Job Order is not ready for final inspection, the Professional will report the reasons for such determination to the Contractor. In such case, the Contractor shall then submit a revised request for final inspection when those reasons have been resolved. Once the Professional determines the Work of the Job Order is ready for final inspection, the Prime Professional will call for final inspection of the Project with the Owner for the purpose of determining whether the Work of the Job Order is acceptable under the Contract Documents.

B. **Owner's Inspection**: After the Professional has ascertained the Work of the Job Order to be ready, an Owner's inspection will be scheduled within ten (10) days thereafter. The Contractor will have not more than thirty (30) days thereafter, unless a longer time for specific items is mutually agreed to in writing by the Owner and Contractor to make any corrections of the final punch list items and to submit closeout documents.

C. **Correction of Work Before Final Payment**: The Contractor shall address all defects or discrepancies noted on the final punch list and promptly remove from the Owner's premises all materials condemned for failure to conform to the Contract, whether incorporated in the Work or not, and the Contractor shall, at his own expense, replace such condemned materials with those conforming to the requirements of the Contract. Failure to remedy such defects or discrepancies after thirty (30) days, unless a longer time for specific items is mutually agreed to in writing by the Owner and Contractor, will allow the Owner to make good such defects and such costs shall be deducted from the balance due the Contractor, or charged to the Contractor in the event no payment is due.

1.03 **CLOSEOUT DOCUMENTS**

Unless otherwise notified, the Contractor shall submit to the Owner through the Professional, three (3) copies of the following before final payment is made:

A. **Request for Final Payment**: AIA Document G702, current edition, completed in full or a computer generated form having similar data.

B. **Consent of Surety Company to Final Payment**: AIA Document G707, current edition, completed in full by the Bonding company.

C. **Power of Attorney**: Closeout documents should be accompanied by an appropriate Power of Attorney.

D. **Release of Liens and Certification that All Bills Have Been Paid**: AIA Document G706A, current edition, completed in full or a sworn statement and affidavit from the Contractor to the Owner stating that all bills for this job have been paid and that the Owner is released from any and all claims and/or damages.

E. **Contractor's Affidavit of Payment of Debts and Claims**: AIA Document G706, current edition, completed in full.

F. **Guarantee of Work**: Sworn statement that all work is guaranteed against defects in materials and workmanship for one (1) year from date of Owner's acceptance, except where specified for longer periods.

1. Word the Guarantee as follows, or in a similar manner:
   *We hereby guarantee all work performed by us on the above captioned Project to be free from defective materials and workmanship for a period of one (1) year or such longer period of time as may be called for in the Contract Documents for such portions of the Work.*
2. All guarantees and warranties shall be obtained in the Owner's name.
3. Within the Guaranty period, if repairs or changes are requested in connection with guaranteed work which, in the opinion of the Owner, are rendered necessary as a result of the use of materials, equipment or workmanship which are inferior, defective or not in accordance with the terms of the Contract, the Contractor shall promptly, upon receipt of notice from and without expense to the Owner, place in satisfactory condition building, site, equipment or contents thereof. The Contractor shall make good any work, materials, equipment or contents of said buildings or site which may be disturbed by fulfilling any such Guaranty.

4. If, after notice, the Contractor fails to proceed promptly to comply with the terms of the Guaranty, the Owner may have the defects corrected and the Contractor and his Sureties shall be liable for all expense incurred.
5. All special guarantees applicable to definite parts of the work stipulated in the Project Manual or other documents forming part of the Contract shall be subject to the terms of this paragraph during the first year of the life of such special guaranty.

G. **Project Record Documents**: Furnish all other record documents as set forth in Section 01 7800 entitled *Project Record Documents*. Failure provide such documents within thirty (30) days of Request for Final Payment shall result in the Owner, in consultation with the Professional, determining a fair market value of such documents with such costs to be retained or deducted from the balance due the Contractor, or charged to the Contractor in the event no payment is due.

H. **Additional Documents Specified Within the Project Manual**: Provide all additional certificates, warranties, guarantees, bonds or documents as called for in the individual sections of the Project Manual. The Contractor is responsible for examining the Project Manual for these requirements. Failure provide such documents within thirty (30) days of Request for Final Payment shall result in the Owner, in consultation with the Professional, determining a fair market value of such documents with such costs shall be deducted from the balance due the Contractor, or charged to the Contractor in the event no payment is due.

# PROJECT RECORD DOCUMENTS
## SECTION 01 7800

1.01 **DESCRIPTION**

A. **Scope**: To set forth the procedure and requirements for keeping project record documents.

B. **Maintenance Documents**:
1. Throughout the Contract, maintain one (1) copy of all of the following: Contract Drawings, Project Manual, Addenda, Change Order(s), reviewed shop drawings, reviewed submittals, hardware schedules, field, and laboratory test records, equipment brochures, parts lists, operating instructions and other modifications to the Contract.
2. Store documents on site apart from documents used for construction.
3. Maintain documents in clean, dry, legible condition. Do not use record documents for construction purposes.
4. Make documents available, at all times, for inspection by the Professional, Commissioning Authority Professional, and the Owner.
5. Keep documents in 8 ½" x 11" loose leaf binders. Clearly label each binder on the spine. Sub-divide with permanently marked tabs of card stock. Provide a main tab for each specification section. Provide sub-tabs for each major piece of equipment or component.
6. Format for information behind each tabbed piece of equipment/component shall be:
    a. Contractor/Installer Information: Include address, phone number and contact name. Include emergency service contact information as applicable.
    b. Manufacturer Information: Include address, phone number and contact name.
    c. Shop Drawings and Product Data
    d. Operation and Maintenance Instructions
    e. Control Drawings

C. **Recording**:
1. **General**: Mark all modifications in red pencil. Keep record documents current. Do not permanently conceal any work until required information has been recorded.
2. **Contract Drawings**: Legibly mark to record actual construction.
    a. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.

b. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
c. Field changes in dimension and detail.
d. Changes made by change order(s) or field order(s).

3. **Project Manual and Addenda**: Legibly mark up each section to record Manufacturer, trade name, catalog number and Supplier of each product and item of equipment actually installed.
4. **Shop Drawings**: Maintain as record documents. Legibly mark drawings to record changes made after review.

D. **Submittal**: At completion of Project, deliver two (2) copies of each record document to the Professional, who will transmit both sets to the Institution or Agency. Additionally, provide to Owner updated As-Built Contract Documents in electronic format utilizing electronic format copy of Contract Documents furnished by Professional or by scanning of marked-up contract Documents.

# SPECIAL REQUIREMENTS
## SECTION 01 8000

### PART 1 - SUMMARY OF WORK SUPPLEMENT

1.01 **WORK SEQUENCE**

A. Owner will occupy the building during construction, coordinate with Owner's Representative in scheduling work to vacate the areas as the Contractor requires.

B. Construct work in stages as follows:
1. _____
2. _____
3. _____

1.02 **PARTIAL OWNER OCCUPANCY**

A. Schedule early completion of designated areas for Owner's usage prior to substantial completion of entire Project as follows: _____

B. Owner will occupy the following areas throughout the Project or during portions of the Project as follows: _____

C. Prior to occupancy of any portion of the Project, a *Certificate of Substantial Completion* for designated areas shall be executed establishing responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance for such portion of the Work.

### PART 2 - ALLOWANCE SUPPLEMENT

2.01 **SCHEDULE OF ALLOWANCES**

A. Include in the Bid, for inclusion in the Contract Sum, the amount of $_____for purchase of _____

(Refer to Section _____, _____)

B. Include in the Bid, for inclusion in the Contract Sum, the amount of $_____for purchase of _____

(Refer to Section _____, _____)

### PART 3 - ALTERNATE SUPPLEMENT

3.01 **DESCRIPTION OF ALTERNATES**

A. Alternate Number One. Exterior Masonry Repair as described on Sheets 8.0 and 9.0 of the Drawings.

B. Alternate Number Two. Not used.

C. Alternate Number Three. Not used.

D. Alternate Number Four. Not used.

E. Alternate Number Five. Not used.

**PART 4 – CONSTRUCTION FACILITIES AND TEMPORARY**

| | | |
|---|---|---|
| 4.01 | **CONTROLS SUPPLEMENT FIELD OFFICE** | Required |
| 4.02 | **UTILITIES** | To be provided by Using Agency |
| 4.03 | **PROJECT SIGN** | 4'x 8' sign required. See attached drawing. |

**PART 5 – ANTICIPATED DELAYS**

| | | |
|---|---|---|
| 5.01 | **ADVERSE WEATHER** | See Part 7 hereinafter. |

**PART 6 – INSTITUTION/AGENCY REQUIREMENTS**

| | | |
|---|---|---|
| 6.01 | **PROHIBITED ACTIVITIES** | See Part 7 hereinafter. |
| 6.02 | **USE OF PREMISES** | See Part 7 hereinafter. |

**PART 7 - ADDITIONAL SUPPLEMENTARY CONDITIONS - ARCHITECT**

See Part 7 hereinafter.

# THIS PROJECT IS FUNDED BY THE TAXPAYERS OF MISSISSIPPI

## GOVERNOR TATE REEVES

## PROJECT NAME

GS# 111-111
HB1111 or SB1111, LAWS OF 1111

## DEPARTMENT OF FINANCE & ADMINISTRATION

BUREAU OF BUILDING, GROUNDS & REAL
PROPERTY MANAGEMENT

## ARCHITECT

ARCHITECT NAME

## CONTRACTOR

CONTRACTOR NAME
MISSISSIPPI C.O.R. #11111

## USING AGENCY NAME

HEAD OF USING AGENCY NAME
GOVERNING BOARD (WHERE APPLICABLE)

7.01 ADDITIONAL SUPPLEMENTARY CONDITIONS – ARCHITECT

The following items are requirements in addition to the previous Divisions 0 and 1 requirements.

1. Color Schedules: Color schedules will be prepared by the Architect only after the Contractor has furnished ALL necessary submittals involving color selection, complete with samples and color chips, from the actual suppliers and subcontractors. Delivery of this material to the Architect shall occur within 30 days after Notice to Proceed.
2. Use of Site Facilities: Contractor shall not allow tradesmen, technicians, and laborers to enter adjacent existing facilities except as predetermined and approved by the Owner and Architect.
3. Any existing site elements damaged by Contractor shall be repaired to original condition to the satisfaction of the Owner and Architect.
4. "Before" documentation: Prior to the Pre-Construction Conference, the Contractor shall furnish to Architect a full set of "before" photographs, and a "before" videotape, documenting existing site and building conditions. Photo documentation, which must include enough context for location evaluation, shall illustrate all existing damage to building and site for which Contractor would like to not be held responsible. Contractor shall be fully liable for replacement or repair of any site elements, building elements, or finishes that are not clearly documented in the "before" photos/video as being pre-existing to the onset of this Project.
5. Existing utilities shall not be interrupted unless pre-approved by the Owner and the Architect.
6. This project is a no-tobacco job, in accordance with State policy. There shall be no tobacco use (cigarettes, chewing tobacco, vaping, etc.) inside the building or on the site at any time.
7. Asbestos: No products containing asbestos in any form are to be incorporated in this project.
8. Furnishing of Contract Documents: The Contractor will be furnished free of charge any bid sets returned to Architect following bid process.
9. Regulations and Facilities:
    a. The Contractor shall acquaint his subcontractors and workmen with Owner's traffic and parking regulations.
    b. Removal of Rubbish: The Contractor shall keep on hand an adequate crew of laborers and/or other personnel to keep the buildings and surrounding streets, sidewalks, alleys, etc., free from any dirt, rubbish, and other debris resulting from the execution of this contract. Site and premises shall be cleaned on a daily basis.
    c. Use of Premises: All material and equipment shall be brought onto the site by making use of such roadways and drives as designated by the Owner and across the grounds along routes established by the Owner. Any streets, roadways, sidewalks, ground, plantings, trees, or other property that may be damaged as a result of the contract work shall be properly repaired or fully replaced by the Contractor to the full satisfaction of the Owner and Architect. No more space than is absolutely necessary will be permitted to be used on the grounds immediately around the building site; and the Contractor must use every care against damage to the grounds. Any roadway or parking surfacing damaged as a result of construction traffic shall be repaired with full-depth material (asphalt or concrete) to match existing. Limits of such repair will be determined by Owner and Architect, based on pre-existing conditions photographs submitted to the Architect.
    d. Designation of Storage and Working Area: The exact boundaries of the area

that may be used by the Contractor and subcontractors for the storage of materials and as a working area shall be designated by the Architect and Owner at the preconstruction conference. The Contractor must confine his operations within the designated area, providing space for all subcontractors. Any damage to the grounds within the designated work area or storage area shall be repaired by the Contractor and left, on completion, in the same state as found to exist at the start of the work or as shown on the building plans. Such damage shall include repairs or replacements of shrubs and trees. If the Contractor requires additional area for any purpose, a formal written proposal shall be submitted to the Architect and Owner.

e. Designation of Parking Area: If sufficient parking area is not available within the designated storage and working area for the vehicles of workmen employed on the building, the Contractor shall require workmen to park their vehicles in areas designated by the Architect and Owner. Workmen failing to comply with traffic and parking regulations shall be removed from the job at the request of the Architect.

f. Theft and Vandalism: The Owner will not be responsible for the safety of the Contractor's work, materials, or equipment. Protection of the property within the contract work area both day and night shall be the responsibility of the Contractor.

g. Objectionable Workmen: Any workmen who may, because of improper conduct, become objectionable, will be promptly removed by the Contractor at the request of the Architect.

h. Burning: There shall be no burning on properties of the State of Mississippi. All clearing and grubbing, debris, rubbish, trash, and any other material which is subject to burning shall be removed and disposed of outside the limits of State property. It shall be the responsibility of the Contractor to acquire, maintain, and pay for, if necessary, any permits and fees for an EPA Compliant disposal area.

i. Protective Measures: All signs, lights, barricades, covered walkways, signals, fences, etc., required for site safety shall conform to or exceed the requirements of Chapter 33 of the International Building Code (latest edition), Safeguards During Construction. Contractor shall provide temporary plastic construction netting barrier at appropriate height (4' or 6' high) at locations required to protect the public from construction activities. Public entrances, fire exits, and delivery access shall be made freely open and accessible at all times. Sand-bagged posts shall be spaced 10'-0" o.c., maximum.

j. Trees and Plantings: Within the work area trees and plantings shall be protected at all times with fencing at dripline of trees. The Contractor shall also take care to protect trees outside the work area.

k. Critical project sequencing: If required, refer to Section 01900 Division One Supplement.

10. Weather Days: Shall not be allowed for this interior Project.

11. Drawings and Specifications:
    a. Drawing a portion of work in detail and outlining the balance shall mean that such details shall be continued to completion to get the full effect intended by the Architect.

12. Submittals:
    a. ALL submittals shall be submitted within thirty (30) days of Notice to Proceed.
    b. All verbiage in the General and Supplementary Conditions shall be strictly enforced for this Project, including the following:
        1) The Contractor shall under no circumstances submit submittals which

he has not carefully reviewed and coordinated with all trades and the Project as a whole.

2) Under no circumstances shall the Contractor install work, or make preparation for installation of later work or products, until shop drawings or submittals for all pertinent and related materials have been submitted to, and approved, by the Project Professionals.

c. Reproductions for hard copy submittals: Opaque diazo prints. Submit one (1) hard copy of each submittal along with electronic submissions specified at Item "d.", below. All hard copy submittals shall be printed/plotted at a legible scale. Submittals that are not at a legible scale shall be returned to Contractor for re-submittal. NOTE: submittals will not be reviewed until the hard copy is submitted. EXCEPTIONS: For all mechanical/electrical submittals, submit three (3) hard copies of each submittal: one marked copy shall be returned to Contractor, and Contractor shall scan the reviewed/returned shop drawing set for distribution to subcontractors and suppliers.

d. Electronic Submittal Procedures:

1) In addition to the requirements for submission of one (1) hard copy described above, shop drawing and product data submittals shall be transmitted to Architect in electronic (PDF) format. The electronic submittal process is intended to supplement, NOT replace, hard copy submittals (including color samples, color charts, or physical material samples).

2) Procedures:

a. The General Contractor shall submit all digitized submittals, via email, to the Architect.

b. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer/product, dimensions and coordination of information with other parts of the work.

c. Contractor shall transmit each submittal to Architect using email. Architect will review each submittal and provide electronic mark-ups to indicated corrections or modifications required, except at full sheet drawings (e.g., structural steel) which shall be marked on hard copies submitted. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action. Architect/Engineer review comments shall be emailed to the Contractor for use and distribution to his subcontractors and suppliers.

d. Submit color paper copies of reviewed submittals at project closeout for record purposed in accordance with Section 01720 Project Record Documents.

e. Costs:

1) The cost of all scanning/CD services shall be included in the Contractor's Bid.

2) Internet service and equipment requirements:

a. Email address and internet access at Contractor's main office.

b. Adobe Acrobat (www.adobe.com), Bluebeam PDF review software for applying electronic stamps and comments.

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

Allow (20) calendar 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. Intermediate review: If intermediate submittal is necessary, process it in same manner as initial submittal. Resubmittal review: Allow ten (10) days for review of each submittal.

g. Identification and information: Identify and incorporate information in each electronic submittal as follows:
    1) Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
    2) Name file with submittal number or other unique identifier, including revision identifier.
        a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., 102-262.06100.01.01A).
    3) Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.

h. Submittal format:
    1) Sheet size: Except for templates, patterns, and similar drawings, submit scalable electronic Shop Drawing files.
    2) Submit electronic Shop Drawings in the following format: PDF electronic file, editable format.

i. Resubmission requirements:
    1) Shop Drawings: Revise initial drawings, as required, and resubmit as specified for initial submittal. Indicate on drawings any changes which have been made other than those requested by the Architect/Engineer.
    2) Project Data and Samples: Submit new data and samples, as required, for initial submittal.

j. Distribution of Submittals After Review:
    1) Distribute copies of shop drawings and product data which carry Architect/Engineer's stamp to: Contractor's File, Job Site File, Subcontractor, Supplier, and Fabricator.
    2) Distribute samples as directed.

13. The Contractor shall keep a Daily Project Report documenting the conditions which exist and the construction related activities which occur at the Project Site, for every Calendar Day, from the Date of the Notice to Proceed through the Date of Final Acceptance. For any day which is not a scheduled work day (Holiday, Saturday, Sunday), and during which no work was preformed, the Contractor shall indicate on the report only the weather and site conditions which were known to exist on that day.
    a. Report format: Use an 8-1/2" x 11" pre-printed standardized form for reporting the required data.
    b. Information Required: The Daily Project Report shall include the following information as a minimum:
        1. Contractor Identity: Name, address, phone, fax, e-mail.
        2. Project Identity: Name, Location, Architect's project number.
        3. Project Weather Conditions: Clear, partly cloudy, overcast, misting, light rain, heavy rain, hot, cold, warm, temperature range, wind conditions. Include statement indicating impact of Weather Conditions on the work scheduled for that day.
        4. Site Conditions: Clear, muddy, dusty. Include statement indicating impact of Site Conditions on the work scheduled for that day.
        5. Work in Progress (including work begun and completed) with names of entities performing work and number of employees present for each.

6. Visitors to Site.
7. Problems encountered and disposition of each.
8. Summary of Architect's instructions.
9. Name and signature of Contractor's representative who prepared the report.

c. Monthly Submittals:
1. Contractor shall submit two (2) bound sets (in accordance with Submittal Format indicated hereinafter) of copies of the Daily Project Reports with each monthly Application For Payment. One copy will be retained by the Architect and one copy will be forwarded to the Owner's Representative.
2. Record Submittals: Contractor shall provide one (1) bound set, same as for Monthly Submittals to Section 01720 – Project Record Documents, for each Pay Period.
3. Submittal Format:
a. Binders: Commercial quality, 8-1/2" x 11", 3 clasp, softback binder with clear plastic cover, equal to Smead No. 121BK. Identification (Title Page): The first page following the clear cover shall include the following typed information: Project Identity; Contractor Identity; Time Period of Reports.

14. Architect shall not be responsible for mailing or shipping large samples, mockups or submittals to Contractor. Contractor shall pick up submittals from Architect’s office, or shall provide pre-paid shipping envelopes/boxes for Architect’s return of such submittals or samples, or request that Professional deliver to site at next scheduled site visit.
15. Change Order pricing shall not exceed material and/or labor rates as defined by RS Means Building Construction Cost Data, 2020 Edition. Credits to Contract shall not be less than costs defined by the current RS Means Building Construction Cost Data.
16. Weather Days: not allowed.
17. Architect/Engineer shall be given 48-hours’ notice, minimum, before any concrete pour, including grade beams, new slab, and all exterior concrete, to review steel, formwork, substrate, other material mockups, etc.

END OF SECTION

SECTION 02 05 00 - DEMOLITION

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Demolish and remove from the site certain items of existing construction, as indicated either on the Drawings or in the Specifications, and as required to complete the Work under the Contract. Demolition notes are not all inclusive and shall be interpreted as categories of work.

B. Refer to requirements of Section 01045 - Cutting and Patching, Appendix A: Owner-Furnished Asbestos-Containing Materials Survey and Assessment, and Appendix B: Owner-Furnished Lead-Based Paint Survey and Assessment for additional items relating to work of this Section.

### 1.02 WORK BY OWNER

A. Removal of all loose furniture.

### 1.03 JOB CONDITIONS

A. Occupancy: The building and immediate adjacent floors will be occupied during this project.

B. Partial Demolition and Removal: Items indicated to be removed but of salvageable value to Owner or Contractor may be removed from structure as work progresses. Transport salvaged items from the work area as they are removed and protect.

C. Permanent Removal: All materials, fixtures, etc., deemed "trash" by Owner, shall be removed and disposed of away from site.

D. Protections: Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or elements to be demolished, and adjacent facilities or work to remain.

E. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not barricade stairs and corridors that must remain in use. Do not close or obstruct streets, walks or other occupied or used facilities unless specifically required to construct new work.

F. Utility Service: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

### 1.04 NOTIFICATIONS

A. Contractor shall give notice of demolition/renovation work, prior to onset of construction, as required by the Mississippi Department of Environmental Quality, as per "State of Mississippi Demolition/Renovation Notification Form".

## PART 2 - PRODUCTS

### 2.01 EQUIPMENT

A. Equipment used in the execution of the work of this Section shall be a type normally employed for the particular operation for which it is to be used on the Project and must be of a type approved by the Architect and in satisfactory operating condition.

## PART 3 - EXECUTION

### 3.01 PREPARATION AND PROTECTION

A. Protect all adjacent property and existing construction with adequate barricades and covers.

B. Provide interior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.

C. Where construction partitions are required on Drawings, construct with metal studs and plywood, extending from floor to finish ceiling. Cover partition air/dust tight with fully sealed visqueen. Seal from finish ceiling to floor deck with visqueen, lapped and sealed. NOTE: Do NOT permanently attach partitions to existing finishes.

D. Protections: Ensure safe passage of persons around areas of demolition. Conduct operations to prevent injury to existing and adjacent buildings, structures, other facilities, and persons. Protect existing building surfaces from damage which may result from work required for the project. Damage to existing components of the building shall be repaired to the Owner's satisfaction, or replaced if necessary, at no cost to the Owner.

E. Specific areas for protection:
   1. Protect existing areas of the building to remain in use, including existing stairs, elevator lobbies, suite entrances, etc.
   2. Contractor shall review "Appendix A: Owner-Furnished Asbestos-Containing Materials Survey and Assessment". The general contractor and the painting contractor shall also thoroughly familiarize themselves with the lead-based paint findings at “Appendix B”. The general contractor and/or the painting contactor is expected to make all cost provisions, in his bid, for compliance with OSHA regulations for working with, removal, or abrasion of any paint, whether lead-based or not.
   3. All areas of existing building, including all existing finishes & trim to remain, shall be protected during demolition and construction from moisture, dust, debris, etc.

### 3.02 UTILITY SERVICES

A. All existing utility abandoned penetrations through existing floors and walls shall be patched to match existing construction. See Drawings for floor infill details, to be installed at ALL floor penetrations.

3.03 SALVAGEABLE MATERIALS

A. All existing wood base, wood chair rail, picture mould, and other wood mouldings and trim, shall be salvaged for restoration and re-use.

B. Mop sinks.

3.04 DEMOLITION

A. Remove all specific items indicated on Drawings, including certain carpet, certain plaster and gypsum board walls, certain L.A.T. ceilings, certain doors and frames, ceramic floor and wall tile, plumbing fixtures, toilet accessories, other miscellaneous interior finishes, fixtures, devices, etc.

B. Remove any existing items or construction, whether specifically indicated on the demolition plan or not, whose presence impedes or prevents the new construction operations required to complete the Contract.

C. Remove existing mechanical and electrical as described at Sections 22 00 00 and 26 00 00.

3.04 HAZARDOUS MATERIALS

A. See Appendix A, Appendix B.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Remove from the site all debris, rubbish, and other materials resulting from demolition operations that the Owner deems "trash".

B. Transport materials removed from the demolition operations and legally dispose of from the site (burning of combustible materials from demolished structures will not be permitted on the site).

3.06 CLEAN UP AND REPAIR

A. Upon completion of demolition work, remove tools, equipment and demolished materials away from site. Remove protections and leave interior areas broom clean.

END OF SECTION

SECTION 02 41 16 – STRUCTURE DEMOLITION (Alternate #1)

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Demolish and remove from the site certain items of existing construction, as indicated either on the Drawings or in the Specifications, and as required to complete the Work under the Contract. Demolition notes are not all inclusive and shall be interpreted as categories of work. Also, certain items of existing construction shall be salvaged for reuse in the finished Work.

B. Refer also to:
   1. Section 01045 - Cutting and Patching
   2. Appendix A: Owner-Furnished Asbestos-Containing Materials Survey and Assessment
   3. Appendix B: Owner-Furnished Lead Based Paint Survey and Assessment

### 1.02 JOB CONDITIONS

A. Occupancy: Occupancy of adjacent and renovation areas is described under Section 01900 – Division One Supplement.

B. Partial Demolition and Removal: Items indicated to be removed but of salvageable value to Owner or Contractor may be removed from structure as work progresses. Transport salvaged items from the work area as they are removed.

C. Permanent Removal: All materials, fixtures, etc., deemed "trash" by Owner, shall be removed and disposed of away from site.

D. Protections: Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or elements to be demolished, and adjacent facilities or work to remain. Drape plastic over furnishings and equipment in areas that do not have lay-in ceiling to protect such interior items from “fall-out”. Drape and protect all interior finishes, furniture, and equipment to protect such elements from construction dust and debris.

E. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not barricade stairs and corridors that must remain in use. Do not close or obstruct streets, walks or other occupied or used facilities.

F. Utility Service: Maintain all existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

### 1.03 NOTIFICATIONS

A. Contractor shall give notice of demolition/renovation work, and of asbestos abatement, prior to onset of construction, as required by the Mississippi Department of Environmental Quality, as per "State of Mississippi Demolition/Renovation Notification Form".

## PART 2 - PRODUCTS

### 2.01 EQUIPMENT

A. Equipment used in the execution of the work of this Section shall be a type normally employed for the particular operation for which it is to be used on the Project and must be of a type approved by the Architect and in satisfactory operating condition.

## PART 3 - EXECUTION

### 3.01 PREPARATION AND PROTECTION

A. Protect all adjacent property and existing construction with adequate barricades and covers.

B. Provide interior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.

C. General Contractor shall provide necessary temporary wall and floor coverings in corridors and stairs that are being used as paths to and from construction area.

D. Protections: Ensure safe passage of persons around areas of demolition. Conduct operations to prevent injury to existing and adjacent building, structures, other facilities, and persons. Protect existing building surfaces and those of adjacent buildings from damage which may result from work required for the project. Damage to existing components of the building shall be repaired to the Owner's satisfaction, or replaced if necessary, at no cost to the Owner.

### 3.02 UTILITY SERVICES

A. No removal and/or relocation of existing utility lines is allowed. Coordinate disruption of utility lines with Owner so that any temporary cut-off of utilities will impose no undue hindrance on Owner.

B. All holes through existing roof decks, floors, and walls shall be patched to match new and existing construction. All penetrations exposed to view, and where existing materials are removed, shall likewise be patched to match new and existing construction.

### 3.03 DEMOLITION

A. See related general construction Specification Sections and Drawings for more detailed and specific demolition requirements.

B. Remove certain steel window units, adjacent masonry and finishes, as required to install new terra cotta shapes, reinstalling along with new masonry units.

C. Remove certain terra cotta elements as required for replacement.

D. Remove certain natural stone elements as required to restore or replace such elements.

E. Remove all existing sealants, backer rods, mastics, etc. where required to install new sealants.

F. Remove existing mortars where required for repointing scope indicated.

G. Remove existing brick unit masonry as required to perform certain restoration and repair operations. Salvage all brick practicable for re-use.

H. Other items noted in Documents.

3.04 SALVAGEABLE MATERIALS

A. See related general construction Specification Sections and Drawings for more detailed and specific salvageable material requirements.

B. All existing terra cotta and natural stone elements shall be considered salvageable unless specifically noted to be replaced.

C. All existing site appurtenances, including such items as bollards, gates, fences, etc. shall be salvaged.

D. Other items noted in Documents.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Remove from the site all debris, rubbish, and other materials resulting from demolition operations that the Owner deems "trash".

B. Transport materials removed from the demolition operations and dispose of from the site.

3.06 CLEAN UP AND REPAIR

A. Upon completion of demolition work, remove tools, equipment and demolished materials away from site. Remove protections and leave interior areas vacuum clean.

END OF SECTION

SECTION 04 01 40.52 – UNIT MASONRY CLEANING (Alternate #1)

## PART 1 - GENERAL

### 1.01 SUMMARY

A. This Section includes cleaning of exterior brick as follows:
   1. Applying start-of-work cleaning trial samples of all specified cleaning systems.
   2. Cleaning of repointed exterior brick masonry, limestone, and terra cotta, full limestone facades at first/second/partial-third floors, by chemical and water cleaning methods, as determined by cleaning trial samples.
   3. Removal of localized severe soiling or staining from existing exterior masonry in areas of repointing scope.
   4. Providing access to all work areas during cleaning project for inspection by Architect.

B. Related Sections:
   1. Section 04 05 13 – Masonry Mortaring

### 1.02 REFERENCES

A. Except as modified by Construction Documents, applicable portions of the latest editions of following reference documents shall govern the Work.
   1. Secretary of Interior’s Standards for the Treatment of Historic Properties.

### 1.03 DEFINITIONS

A. Very Low-Pressure Water: Less than 100 psi; 4 to 6 gpm.

B. Low-Pressure Water: 100 to 400 psi; 4 to 6 gpm. In some cases, water pressures in the low-pressure range can damage fragile or absorptive masonry.

C. Medium-Pressure Water: 400 to 800 psi; 4 to 6 gpm. Depending on the softness or hardness of the substrate, often a water pressure of greater than 400 psi is not appropriate for masonry substrates and can result in damage.

D. High-Pressure Water: 800 to 1200 psi; 4 to 6 gpm. High pressure water cleaning is not appropriate for masonry substrates and can result in damage.

### 1.04 SUBMITTALS

A. Product Data: submit three copies of manufacturer's product literature, application instructions, and Manufacturer's Safety Data Sheets (MSDS) for all products used in cleaning before the work begins.

B. Samples for Verification: Before erecting mock-up, submit samples of the following upon request by the Architect:
   1. Samples of cleaning chemicals for testing and verification.

C. Qualification Data: For masonry cleaning contractor or subcontractor.
   1. Submit to the Owner and the Architect with the Bid Form a list of similar masonry cleaning projects performed in the previous five (5) years. For each project, include project address, description of cleaning scope of work, list of cleaning materials and systems used, and Owner contact information.
   2. Submit to the Owner and the Architect written qualifications for supervisory personnel and workers who will be performing the cleaning work.

D. Protection Plan: Submit to Architect three copies of a written plan describing all protection measures and systems proposed by Contractor for use during the work.

E. Collection and Disposal Plan: Submit to Architect three copies of a written protection plan describing methods for collection and control of runoff during cleaning operations, as required for cleaning products and systems used.

F. If materials and methods other than those indicated are proposed for cleaning work, provide a written description, including all product required for specified products, evidence of successful use on comparable projects, and a proposed testing program to demonstrate their effectiveness for this project. No cleaning materials and methods other than those specified may be used without prior written approval by the Architect and Owner.

1.05 QUALITY ASSURANCE

A. Cleaning Contractor Qualifications: Engage an experienced, masonry cleaning firm to perform work of this Section.
   1. Firm shall have completed work similar to that indicated for this Project with a record of successful in-service performance.
   2. Contractor performing this work shall have at least five years experience in the cleaning of masonry facade.

B. Cleaning Worker Qualifications: Persons who are experienced and specialize in masonry cleaning work of types they will be performing.
   1. Supervisory personnel shall have not less than five years experience in supervising this type of work. All apprentices shall be under the direct supervision of an experienced supervisor.
   2. Personnel performing cleaning shall have not less than three years experience in masonry cleaning.
   3. Masonry cleaners performing the work shall be experienced in the use of chemical and water cleaning systems.
   4. Keep at the project site, during the period when work is being performed, a competent superintendent/working foreman satisfactory to the Owner.
   5. The approved working foreman shall not be removed from the project without cause or without prior notification of the Owner. If removal is for cause, Contractor shall submit justification in writing within 24 hours of the removal. All work will cease until a new working foreman is on site.

C. Cleaning System Manufacturer Qualifications: Cleaning system shall be provided by a firm regularly engaged in producing masonry cleaners that

have been used for similar applications with successful results, and with technical representatives who are available for consultation and project site inspection and assistance throughout the duration of the project at no additional cost to the project.

D. Trial samples and mock-ups: Prepare trial samples and mock-ups of cleaning as follows to demonstrate effects and qualities of materials and execution. Prepare mock-ups on existing masonry walls under same weather conditions to be expected during remainder of the Work and project.
   1. Prepare a trial of every protection system or device proposed for the protection of the non-masonry and masonry elements. Protection trial may be installed as part of cleaning mock-up areas. The protection trial shall be tested to determine its vulnerability to weather and effectiveness. The Owner may require that the Contractor conduct tests of the protection system before the cleaning work begins.
   2. Execute a trial sample using the materials and techniques for each specified cleaning system. The cleaning systems to be used on the different substrates will be selected based on these trial samples.
      a. Area(s) where trial samples are to be applied shall be selected by the Architect in consultation with the Contractor, and shall be approved by the Owner.
      b. Area of each trial sample shall be 25 square feet for each type of masonry and surface condition.
      c. Trial samples for severe staining and mastic deposits shall be performed at multiple small locations, approximately 2 to 4 square feet each, using selected chemical cleaners and poultices specified herein. Based on results of the trial samples, a variety of cleaners may be required to address these stains and deposits.
      d. Trial samples for removal of coatings shall be performed at two small locations, approximately 2 to 4 feet each, using coating removal product specified herein.
      e. Additional trial samples shall be made until an acceptable result is achieved on each type of material. Note that minor adjustments to methods of application, dilutions, and dwell times of products shall be made in accordance with limits defined in manufacturer's recommendations.
   3. Prior to proceeding with mock-up samples, test all chemical cleaners and cleaning methods for adverse reactions on adjacent masonry materials or other materials that may be affected by the cleaning process, if those materials are to remain unprotected. Test areas of adjacent materials shall be small (less than 2 square feet) and in unobtrusive location. Protect against known deleterious effects of chemical cleaners and cleaning methods during testing.
   4. Do not proceed with work prior to approval of cleaning sample(s) by the Architect and Owner.
   5. Allow a waiting period of not less than fourteen days after completion of sample cleaning to permit a study of sample area for effectiveness of cleaner and for negative reactions.
   6. Protect trial samples during the work. Upon completion of the work and with prior approval by the Architect, trial samples may be incorporated into the overall work.
   7. Approved trial cleaning samples shall be the standard of work for all masonry cleaning on the project.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
B. All cleaning materials stored and used on the site shall be clearly labeled with proper warning to prevent any accidental use of the products by unauthorized persons. Store cleaning materials and equipment at location approved by Owner.
C. Maintain MSDS for cleaning materials with materials in storage area and available for ready reference on project site.

1.07 SEQUENCING AND SCHEDULING

A. Perform cleaning work in the following sequence relative to other masonry work:
   1. Clean representative areas of existing materials and surfaces in accordance with Section 04930 - Masonry Cleaning, prior to matching for new materials.
   2. Coordinate sequence of cleaning work with masonry repairs with Architect prior to proceeding. Contractor should anticipate that cleaning will be performed following masonry repairs, except for localized cleaning to be performed in order to provide substrate for matching materials and colors, and in other selected areas as determined by Contractor and Architect.
   3. Inspect for open joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
   4. Perform masonry cleaning as specified.
   5. Perform masonry repairs and repointing as required after cleaning.

PART 2 - PRODUCTS

2.01 CLEANING MATERIALS

A. Water for Prewetting, Cleaning, and Rinsing (and for cleaning of masonry and cast stone as indicated by trial samples):
   1. Clean, potable water, with iron content of less than two (2) parts per million, or 0.0002 percent (by weight).
   2. Notify Architect and Owner of any conditions of local water that may make it unsuitable for masonry cleaning, including but not limited to the presence of additives, water softeners, or other agents.
   3. Provide test results to confirm the local water is suitable for use in cleaning project.
   4. Where hot water is used in cleaning, heat water to a temperature of 120 degrees Fahrenheit.

B. Mild detergents, surfactants, and chelating agents (for use on brick and cast stone or concrete, as indicated by trial samples):
   1. Triton X-100: Volumetric mixture consisting of Triton X-100 detergent, a mild, non-ionic detergent, mixed with water, 0.1 to 3.0 percent detergent.
   2. EnviroKlean 2010 All Surface Cleaner, an alkaline cleaning liquid pH = 10.5 at up to 1:10 dilution (volume/volume) based on test samples, as manufactured by Prosoco, Inc., of Kansas City, Kansas.
   3. Dumond Chemicals Safe 'n Easy Architectural Cleaner/Restorer, a nonionic surfactant and chelating agent based cleaner, as manufactured by Dumond Chemicals, Inc., New York, New York.

C. Cleaner for removal of organic growth (one of the following, as determined

by trial samples:

1. Job-mixed biocide: Volumetric mixture consisting of the following: 1 quart of 5 percent calcium hypochlorite or sodium hypochlorite (household bleach), plus 2/3 cup trisodium phosphate-type detergent plus 1/3 cup household detergent powder, mixed in 4 quarts warm, potable water.
2. D/2 Architectural Cleaner - Biocide D/2 Architectural Antimicrobial, a quaternary ammonium chloride solution, pH = 9.5 at undiluted concentration, distributed by Limeworks.US of Milford Square, Pennsylvania, www.limeworks.us.

D. Cleaner for removal of ferrous staining (as indicated by trial samples):
   1. Oxalic acid, 10 percent solution in clean, potable water.

E. Chemical cleaning systems (for use on brick, as indicated by trial samples):
   1. Afterwash: SureKlean Limestone and Masonry Afterwash, an acidic liquid, pH = 1.10 (in concentrate) at 1:1 dilution (volume/volume), as manufactured by Prosoco, Inc., of Kansas City, Kansas.

F. Poultices (as needed for cleaning of localized severe stains and for removal of mastic from masonry substrates, as indicated by trial samples). Note that poultice material will be mixed with selected chemicals for removal of severe stains and mastic deposits:
   1. Inert clay materials composed of 80 percent attapulgite and 20 percent kaolin by volume, mixed with selected cleaning chemical.
   2. 1260 Limestone and Marble Poultice, a low odor paste poultice, as manufactured by Prosoco, Inc., of Kansas City, Kansas.
   3. SureKlean Marble Poultice, an odorless, non-acidic blend of dry absorbent clays and biodegradable detergents, as manufactured by Prosoco, Inc., of Kansas City, Kansas.
   4. Arte Mundit latex bound pack, a series of peelable poultices with an EDTA cleaner in a resin dispersion system, as manufactured by FTB Restoration, of Brussels, Belgium.

G. Cleaner for reinstalled and/or repointed brick masonry:
   1. SureKlean Limestone and Masonry Afterwash, an acidic liquid, pH = 1.10 (in concentrate) at 1:1 dilution (volume/volume), or stronger as may be required, as manufactured by Prosoco, Inc., of Kansas City, Kansas.

I. Water misting or soaking:
   1. Clean, potable water, meeting all requirements specified for water used in prewetting, cleaning, or rinsing, applied at very low pressures.

J. No cleaning products containing hydrochloric (muriatic) acid, hydrofluoric acid, or ammonium bifluoride shall be used on this project at any time.

## PART 3 - EXECUTION

### 3.01 PROTECTION

A. Comply with all applicable safety codes and regulations that govern the work, including city, state, water department, OSHA and Federal regulations covering protection and waste water disposal.

B. Take any precautions necessary to insure the safety of pedestrians and

those working in the building.

C. Comply with chemical cleaner manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products.

D. Exercise caution in performing the work so as not to damage adjacent building elements. Protect the adjacent building features from mechanical damage due to scaffolding and other equipment.

E. Protect windows and doors, joints, and other openings from chemicals and water infiltration.

F. Protect materials being cleaned from cleaners not designated for use on these substrates.

G. Protection from cleaning systems shall be by one of the following methods:
   1. Polyethylene sheets, no less than 6 mil thick, taped around the entire opening to provide an impervious barrier to the chemical cleaning process. Backing for the polyethylene sheets may be necessary to secure the sheets and provide a wind-proof, watertight system.
   2. An approved strippable mask of sufficient thickness and applied without bubbles, holes, or defects to adequately protect the surface underneath.
   3. Other protection as proposed by the Contractor and approved by the Architect and Owner to provide an impervious barrier.

H. Repair any building materials that have been damaged, where paint has been removed, glass that has been etched, or materials otherwise damaged by the cleaning work to the satisfaction of the Architect without additional cost to the Owner.

3.02 CLEANING MASONRY, GENERAL

A. The purpose of the cleaning process is to remove atmospheric deposits, soil, staining, grease, oil, mortar smear, and other contaminants without damage to or disintegration of the masonry surface.

B. The result of the cleaning is not expected to return the facade to a 100 percent clean or new appearance. The level of cleaning shall be as approved in the trial samples as specified herein.

C. The cleaning system shall not damage, etch, burn, bleach, streak, or discolor any masonry surface.

D. It is recognized that variations of the cleaning materials and their application may be required as the job proceeds. However, no variation will be acceptable without written approval of the Architect.

E. Notify Architect if any conflict is encountered between the specifications and the manufacturer's recommendations for the cleaning product or system.

F. Use only those cleaning methods and materials indicated for each masonry material and location.
   1. Do not use wire brushes or scrapers. For chemical cleaning, use only brushes that are resistant to chemical cleaners being used.
   2. Use spray equipment that provides controlled application at volume and

pressure indicated, measured at spray tip. All pressure applicators shall be equipped with pressure gauges at the compressor and at the spray nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.

3. For chemical cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with cone-shaped spray tip, or other pump as recommended by manufacturer of cleaner. Control wind drift of chemical cleaners if spray application is used.
4. For heated water spray application, use equipment capable of maintaining temperature at 120 degrees Fahrenheit at flow rates indicated.
5. For steam application, use steam generator capable of delivering live steam at nozzle.

G. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.

H. Water Spray Applications: Unless otherwise indicated, hold spray nozzle at least 12 inches from surface of masonry and apply water in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.

I. Prewetting and Rinsing Procedures:
1. Prewetting shall be performed at very low water pressures (measured at the tip), and rinsing shall be performed at low pressures (measured at the tip), using warm water at a flow rate of not less than four gallons per minute. Hot water may be used to improve effectiveness of cleaning and rinsing. Do not use higher prewetting or rinsing pressures, or lower flow rates, unless indicated by approved trial samples and mock-ups.
2. For prewetting, only apply cleaning chemicals to area that remains wet immediately at beginning of cleaner application. On hot days or in direct sunlight, it may be necessary to proceed with prewetting and cleaner application to small areas of surface, or to prewet the surface several times during the cleaner application.
3. For prewetting and rinsing, use a stainless steel spray trip giving a 45 degree fan spray, held at least 12 inches from the wall surface.
4. Rinse off chemical and soil residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting.
5. Continue rinsing until pH of wall has returned to neutral (6.5 to 7.5).
    a. Maintain pH paper on site to check pH of rinsed surface.
    b. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
    c. Repeat application of neutralizing afterwash (if specified) and rinsing as necessary to produce tested neutral pH (6.5 to 7.5).
6. Recheck pH of wall 48 hours after cleaning has been completed, when wall is dry.

J. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

K. Apply cleaning materials in strict compliance with the manufacturer's written instructions and as specified.

3.03 CHEMICAL CLEANING PROCEDURES

A. Triton X-100 cleaning:
   1. Prewet wall surface with very low pressure water.
   2. Apply cleaning solution with soft natural bristle brush. Allow to dwell for 3 to 5 minutes. Dwell time to be confirmed by approved test samples.
   3. Gently scrub surface with soft brush.
   4. Rinse thoroughly with low pressure warm water.

B. EnviroKlean 2010 cleaning:
   1. Prewet wall surface with very low pressure water.
   2. Liberally apply diluted EnviroKlean 2010 All Surface Cleaner to the surface using a soft-bristled nylon brush, being careful to completely cover surface of area, including crevices. Allow to dwell for 15 minutes. Dwell time to be confirmed by approved test samples.
   3. On areas of cleaning exposed to wind or sunlight, monitor areas of work during dwell time to insure that applied cleaners do not dry on the surface. Areas that begin to dry should be lightly misted with water.
   4. Just prior to rinsing, agitate surface again by scrubbing gently and thoroughly with a nylon bristle brush.
   5. Rinse thoroughly with low pressure warm water. Rinse the wall with clean water until the pH of the surface has returned to neutral.
   6. Repeat cleaning sequence described above as necessary until cleaning standard established by approved samples is met.
   7. The wall should be rinsed until the pH of the surface has returned to neutral. This may take a minimum of 5 minutes. A second rinse within an hour of the first for at least 2 additional minutes shall be performed to remove any cleaner residue. This second rinsing shall be performed with very low pressure water.
   8. The pH of the wall surface shall be tested after final rinsing of cleaning solutions to confirm the pH of the surface has returned to neutral.

C. Dumond Chemicals Safe 'n Easy Architectural Cleaner/Restorer:
   1. Prewet wall surface with very low pressure.
   2. Scrub on cleaning solution with soft, natural bristle brush. Allow to dwell for approximately 15 minutes. Dwell time to be confirmed by approved test samples.
   3. Rinse thoroughly with low pressure water. Agitate with scrubbing brush during rinsing.
   4. Rinse the wall with clean water until the pH of the surface has returned to neutral.
   5. Repeat cleaning sequence described above as necessary until cleaning standard established by approved samples is met.
   6. The wall should be rinsed until the pH of the surface has returned to neutral. This may take a minimum of 5 minutes. A second rinse within an hour of the first for at least 2 additional minutes shall be performed to remove any cleaner residue. This second rinsing shall be performed with very low pressure water.
   7. The pH of the wall surface shall be tested after final rinsing of cleaning solutions to confirm the pH of the surface has returned to

neutral.

D. Job-mixed biocide:
   1. Prewet substrate to be cleaned and allow to surface dry.
   2. Scrub on cleaning solution with soft, natural bristle brush. Allow to dwell for approximately 15 minutes. Keep surface moist by misting if necessary during dwell.
   3. Rinse thoroughly with very low pressure water. Agitate with scrubbing brush during rinsing.

E. D/2 Biological Solution:
   1. Prewet substrate to be cleaned.
   2. Scrub on undiluted D/2 Biological Solution with soft, natural bristle brush.
   3. Allow to dwell for approximately 1 to 2 minutes.
   4. Apply additional cleaner to maintain a wet surface.
   5. Lightly mist with water and continue scrubbing. (Note that for lighter deposits, D/2 can be diluted 1:1 to 1:4 parts water by volume. Dilutions should be allowed to remain on the surface for 2 to 10 minutes.
   6. Rinse thoroughly with very low pressure water. Agitate with scrubbing brush during rinsing.

F. Oxalic acid solution:
   1. Prewet wall surface with water.
   2. Liberally apply oxalic acid solution to the surface using a soft natural bristled brush, being careful to completely cover surface of area, including crevices. Allow to dwell for 15 minutes. Dwell time to be confirmed by Contractor's test samples.
   3. On areas of cleaning exposed to wind or sunlight, the areas of work should be monitored during dwell time to insure that applied cleaners do not dry on the surface. Areas that begin to dry should be lightly misted with water.
   4. Just prior to rinsing, agitate surface again by scrubbing gently and thoroughly with a natural bristle brush.
   5. Rinse thoroughly with water at low pressure. Rinse the wall with clean water until the pH of the surface has returned to neutral.
   6. Repeat cleaning sequence described above as necessary until cleaning standard established by approved samples is met.
   7. Rinse thoroughly with low pressure warm water until the pH of the surface has returned to neutral. This may take a minimum of 5 minutes. A second rinse within an hour of the first for at least 2 additional minutes shall be performed to remove any cleaner residue. This second rinsing shall be performed with very low pressure water.
   8. The pH of the wall surface shall be tested after final rinsing of cleaning solutions to confirm the pH of the surface has returned to neutral.

G. Cleaning newly reinstalled and newly pointed masonry:
   1. Dilute Afterwash with 1 part water to 1 part cleaner.
   2. Prewet wall surface with very low pressure water (less than 100 psi) for one full minute) to fill the sub-surface brick pores with water. Also pre-wet all areas adjacent to and below the area to be cleaned.
   2. Immediately apply diluted Afterwash liberally to wet surface, using a natural dense-fibered brush (with 1 to 1½ inch bristle length) and being careful to completely cover surface of area including crevices. Allow to dwell for 20 minutes. Keep surface moist by misting as

necessary during dwell time. Do not allow cleaner to dry on surface.
3. Immediately prior to rinsing, scrub gently and thoroughly with natural bristle brush, being careful to completely cover surface, including crevices.
4. Rinse thoroughly with low pressure (less than 200 psi) warm water. Continue rinsing until neutral pH is achieved at wall surface. Maintain pH paper on site to check pH of rinsed surface.
5. Repeat application of cleaner and rinsing as necessary to match approved samples. Repeat rinsing as necessary to reach acceptable pH.
6. Allow surface to dry completely, for 14 days, prior to assessing the level of cleaning effectiveness.

H. Poultices:
1. Prewet surface thoroughly with very low pressure water. Mix chemical into poultice. Chemical for use with poultice will be selected by Architect based on trial samples using specific chemical cleaners. Note that different chemicals may be used with poultice to address different stain or mastic deposit locations.
2. Apply to masonry at stain or mastic deposit location.
3. Cover applied poultice with plastic.
4. Allow poultice to dwell 24 hours.
5. Allow poultice to dry.
6. Remove poultice using wood scrapers and brushes.
7. Scrub surface with soft brushes and use vacuum as needed to remove poultice residue.

3.04 WATER CLEANING PROCEDURES

A. Cold-Water Wash: Use cold water applied by low pressure spray. Water pressures shall be as specified for each product above; however, under no circumstances shall any water pressure exceed 400 psi.

B. Cold Water Mist and Soak:
1. Apply cold water by intermittent soaking.
2. Use spray rack or perforated hoses or other means that will apply a fine water mist to entire surface being cleaned.
3. Apply water in cycles with at least 30 minutes between cycles. Duration of application will be as determined by test samples.
4. Continue water application until surface encrustation has softened sufficiently to permit its removal by water wash, as indicated by cleaning tests.
5. Remove soil and softened surface encrustation from masonry with cold water applied by low-pressure spray.

C. Hot-Water Wash: Use hot water applied by low pressure spray.

D. Steam Cleaning: Apply steam at pressures not exceeding 80 psi.

3.05 CLEAN-UP

A. The premises shall be kept in clean and orderly condition at all times during the progress of the work. Rubbish, barriers, dirt, debris, tools, equipment, and unused materials shall be removed from the site each day.

B. The sidewalk shall be thoroughly rinsed of all chemicals, dirt, pollutants,

and other materials washed off the building each day.

C. Remove all empty drums, cleaning materials, and related supplies from the site.

D. After cleaning has been completed, remove any protection.

END OF SECTION

SECTION 04 05 13 – MASONRY MORTARING (Alternate #1)

## PART 1 - GENERAL

### 1.01 SUMMARY

A. Work included:
   1. Remove existing mortar joints from the building at existing brick masonry, natural stone veneer, and terra cotta trim that are damaged, loose, debonded, missing, deteriorated, etc., including sealant and/or other joint filler materials; repoint all removed joints with mortar.

B. Related Sections:
   1. Section 04 21 29 – Terra Cotta Restoration
   2. Section 04 21 30 – Terra Cotta Fabrication
   3. Section 04 43 00 – Stone Masonry
   4. Section 04 01 20.52 – Masonry Cleaning
   5. Section 07 90 00 – Joint Protection

### 1.02 REFERENCES

A. Except as modified by the Project Specifications, applicable portions of the following reference standards shall govern the work. All standards latest edition as of the date of the Specifications:
   1. "The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Restoring, and Reconstructing Historic Buildings", published by the National Park Service (NPS), U.S. Department of the Interior (DOI).
   2. *Preservation Brief No. 2: Repointing Mortar Joints in Historic Masonry*, National Park Service, U.S. Department of the Interior.
   3. American Society for Testing and Materials (ASTM)
      a. ASTM C33 - Standard Specification for Concrete Aggregates
      b. ASTM C144 – Standard Specification for Aggregate for Masonry Mortar
      c. ASTM C150 – Standard Specification for Portland Cement
      d. ASTM C207 – Standard Specification for Hydrated Lime for Masonry Purposes
      e. ASTM C270 – Standard Specification for Mortar for Unit Masonry
      f. ASTM C780 – Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
   4. Brick Institute of America (BIA)
      a. BIA Technical Note 1 – Cold and Hot Weather Construction
      b. BIA Technical Note 8A – Standard Specification for Portland Cement-Lime Mortar for Brick Masonry, BIA Designation M1

### 1.03 DEFINITIONS

A. Original mortar: Mortar used in the original construction of the masonry wall.

B. Pointing: Installing new mortar into a properly prepared joint between masonry units.

C. Repointing: Removal of the outer portion of existing masonry joints from between masonry units to a specified depth and installing new mortar as specified.

D. Setting mortar: Mortar used in construction to act as a leveling and bonding agent for the masonry units.

E. Tuckpointing: Synonymous with repointing

1.04 SUBMITTALS

A. Product Data: Materials description for all materials to be used in Work

B. Material Certificates: Prior to delivery, submit to the Owner and Architect certificates attesting to compliance with the applicable Specifications referenced herein of the following:
1. Portland cement. Include brand, type, and name of manufacturer.
2. Hydrated lime. Include brand, type, and name of manufacturer
3. Aggregate. Include type, sieve analysis and supplier.
4. Color admixtures. Include brand, type, and name of manufacturer

C. Test Reports: Test reports from an independent laboratory for all required tests.

D. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients

1.05 QUALIFICATIONS

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

B. Contractor: Must have a minimum of five (5) years experience in construction and supervision of masonry work. See additional requirement at 1.06 hereinbelow.

C. Masons must have a minimum of three (3) years experience in the preparation and installation of masonry mortar. Apprentices must be fully supervised by an experienced tradesman. See additional requirement at 1.06 hereinbelow.

D. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

E. Manufacturers: Materials shall be obtained only from manufacturers who will, if required, send a qualified technical representative to the project site, for the purpose of advising the Contractor of the procedures and precautions for the use of the materials.

F. Field Quality Control: Work in place shall be subject to inspection testing. Work found to be unacceptable shall be replaced with new, acceptable work.

1.06 QUALITY ASSURANCE

A. Specialty Masonry Restoration Contractor Qualifications: Engage an experienced masonry restoration specialty contractor to complete the work of this Section. Demonstrate that the specialty contractor has completed masonry restoration work similar in material, design, scale, and scope to that indicated for this Project, with a record of successful in-service performance of not less than five years.
   1. Relevant Experience: Specialty contractor shall present a minimum of ten or more completed projects that demonstrate the specialty contractor's qualifications to perform this work to the satisfaction of the Architect, and in accordance with recognized industry standards. The written document shall include a separate report for each of the qualifying projects being presented. The repointing/restoration projects shall be either designated Mississippi Landmark buildings, or designated National Register buildings. Include in-progress, and completion, photos of each project, with Owner and Architect references (references must be current and able to be located).
   2. Skilled and Available Craftsmen: Specialty contractor shall present evidence of sufficiently skilled and available craftsmen to perform the work of this Section in accordance with the project schedule.
      a. Field Supervision: Specialty contractor shall maintain experienced, full-time supervision of the work in progress at all times, and during all phases, of the restoration process. Demonstrate a minimum of five years of experience directly relevant to the work of this Section for all persons designated to serve in a supervisory capacity on this Project. Do not change supervisors during the course of the restoration Project.
      b. Workers and Installers: Special contractor shall demonstrate a minimum of three years of experience related to the work included in this Section. Fully supervise apprentices with a qualified tradesperson.
      c. Knowledge of the Contract Documents: Specialty contractor shall ensure that workers and supervisory personnel are familiar with, and have ready access to, the most current drawings and specifications pertaining to the work of this Section.

B. Contractor: Must have a minimum of five (5) years experience in construction and supervision of masonry work.

C. Masons must have a minimum of three (3) years experience in the preparation and installation of masonry mortar. Apprentices must be fully supervised by an experienced tradesman.

D. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry,

from one manufacturer for each cementitious component and from one source and producer for each aggregate.

E. Manufacturers: Materials shall be obtained only from manufacturers who will, if required, send a qualified technical representative to the project site, for the purpose of advising the Contractor of the procedures and precautions for the use of the materials.

1.07 FIELD SAMPLES

A. Samples shall be prepared by qualified personnel who will be performing the work. Before work commences, the sample locations shall be approved by the Owner's Representative and Architect. The approved samples shall be the standard for the work.

B. Provide a sample of the method of removing mortar from brick joints in area of twenty-five (25) square feet, and a sample of mortar removal from stone joints in an area of 25 square feet. Provide a sample of terra cotta joint removal in a length of five (5) linear feet.

C. Provide a range of samples of mortar for color selection. The mortar shall match the color, texture, and appearance of existing cleaned mortar at representative areas of brick and cast stone masonry, as determined and selected by Architect.

D. Pointing: Provide a sample of twenty-five (25) square feet minimum of pointed brick, and 25 square feet of natural stone, matching joint profile shown on Drawings, for each type of installation. Provide 5 LF of terra cotta pointing.

E. Leak testing: refer to Section 04510 for random leak testing requirements for repointed masonry.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in manufacturer's sealed packaging and store unopened until required for use. Materials in broken packages or showing evidence of damage will be rejected.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Do not use frozen materials mixed with or coated with ice or frost. When temperature or surrounding air is 50°F and falling, take precautions to protect masonry materials from freezing. Comply with "Cold and Hot Weather Construction," BIA Technical Note 1.

D. Materials shall not be stored in such a manner as to damage or place undue stress on the existing structure or the roof membrane of the building.

E. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

A. Cementitious Materials. (Note that masonry cements shall not be used.)
   1. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
   2. Hydrated Lime: ASTM C 207, Type S

B. Aggregates for Mortar
   1. ASTM C 144 except that the grading shall comply with the limits specified in Section 4.3 of BIA M1. Use aggregate meeting ASTM C33 where required to match existing aggregate. Sand shall contain no more than 50 parts per million of chloride ions. Sand shall be free of organic contaminants.
   2. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

C. Water
   1. Clean and potable.
   2. Free from deleterious amounts of acids, alkalis or organic materials.

D. Admixtures
   1. No admixtures shall be used without prior written approval by Architect.
   2. No calcium chloride or admixtures containing calcium chloride shall be used in the mortar.
   3. No air-entraining admixtures or material containing air-entraining admixtures shall be used in the mortar.

### 2.02 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless specifically approved in advance by Architect in writing.
   1. Do not use calcium chloride in mortar.
   2. Limit cementitious materials in mortar to Portland cement and lime.

B. Mortar for Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
   1. For setting and pointing exterior existing, and salvaged, brick and cast stone masonry, use Type N mortar.
   2. Type N Mortar: 1 part lime to 1 part portland cement to 6 parts sand.

C. Color Matching:
   1. Match color of existing mortar indicated to remain, unless specified otherwise.
   2. Match mortar color by varying color of natural sand used in mortar mix. Natural and synthetic oxides of iron and chrome,

compounded for use in mortar, may be used with prior approval by Architect. Use only inorganic pigments with proven record of satisfactory performance.

3. Do not exceed pigment to mortar ratio of 1:10. Do not re-temper mortar containing color pigments.
4. Final mortar colors in Field Samples are to be approved by the Architect.

## PART 3 - EXECUTION

### 3.01 MORTAR MIXING

A. Except as specified herein, thoroughly mix cement, lime, and sand in accordance with requirements of BIA M1.

B. Control batching procedure to insure proper proportions by measuring materials by volume with known volume containers.

C. Do not measure mortar materials by shovels.

D. All mortar mixing is to be accomplished using a mechanical mixer. Use a 1 cu. ft. box or other device to ensure that mortar is properly proportioned in accordance with Contract Documents. Discard all unused mortar 2-1/2 hours after initial mixing

### 3.02 SETTING MORTAR

A. Set brick or cast stone units to be newly installed or reinstalled in full bed of mortar.

B. Install brick or cast stone in accordance with other Division 4 sections.

C. Mortar may be retempered by adding water and remixing as required for workability. Do not use mortar if more than 1-1/2 hours have elapsed since the pre-hydration of mortar has been completed, at which time mortar shall be discarded.

D. Lay up brick or cast stone units with joints raked back; point joints in new or reinstalled masonry work when adjacent repointing work is performed.

E. Wipe excess mortar from surfaces of exposed brick, terra cotta, or limestone.

### 3.03 PREPARATION OF JOINTS FOR REPOINTING

A. For preparation of joints to be pointed or repointed:
   1. Grind out a narrow line along the center of the length of the mortar bed joints to a depth of 2.5x the joint width (or 3/4 inch minimum) or to sound mortar, whichever is deeper, but not greater than 2 inches. Remove mortar for width of bed joint with hammer and chisel, then remove mortar from head joints with chisel (no power tools allowed). Remove all mortar to a depth

of 2.5x the width of the joint: 3/4 inch minimum, 2 inch maximum, removing all unsound mortar. Remove additional mortar if it is found to be unsound. Remove any traces of mortar at joint interface to be pointed. When cutting is complete, remove all loose material with a brush and oil-free compressed air.

2. When joints are being partially removed and repointed, cut out must key into adjacent joints 2" minimum past the nearest head joint.
3. All preparation of joints shall be in accordance with approved test sample.

B. Rake out all caulked joints. Remove mortar to depths specified above. Remove any traces of sealant in joint or at joint interface to be pointed.

C. Care shall be taken during mortar and sealant removal not to damage the masonry units. Adjacent stone shall not be damaged during grinding and cutting out of joints. Mortar shall be removed without loss or damage of adjacent stone.

D. Power Tools: Power tools shall be used in preparation of joints for repointing only as approved for use by Architect, Owner, and Miss. Dept. of Archives and History after successful completion of a field sample. Light pneumatic tools or vibrating cutters may be used if their use does not damage the adjacent masonry units as determined by the Architect. The use of any mortar removal technique or tool that damages adjacent brick or stone surfaces will not be allowed.

3.04 REPOINTING MORTAR MIXING

A. Use Type N mortar proportion for re-pointing mortar mix.

B. Pre-hydrate mortars, thoroughly mixing all ingredients except water; then, mix again, adding only enough water to produce a damp workable mix which will retain its form when pressed into a ball. After keeping mortars in this dampened condition for 1 to 1-1/2 hours, add sufficient water to bring it to the proper consistency; that is, somewhat drier than conventional masonry mortars. Do not use mortar if more than 2 hours have elapsed since the initial mixing of the mortar, after which time mortar shall be discarded.

3.05 MORTAR INSTALLATION

A. Install in accordance with BIA Standards

B. If mortar begins to stiffen, it may be retempered.

C. Use mortar within 2-1/2 hours of initial mixing.

D. Dampen the joint to be pointed prior to pointing. The masonry must absorb all surface water. Adjacent masonry surfaces must be free of surface water.

E. Pack the mortar tightly into the joint in thin layers (1/4 inch maximum layer thickness). Allow each layer to become thumbprint dry before applying next layer.

F. Tool joint to concave profile (match existing).

G. Wipe excess mortar from surface of stone adjacent to mortar joint with damp sponge or cloth. Note: Use only sponge or cloth that is damp, not wet or saturated. When tightly squeezed water shall not run from damp sponge or cloth. Surface of masonry shall not have visible accumulation of water immediately after cleaning. Do not touch or disturb newly installed pointing mortar during cleaning. Clean until mortar and mortar haze is removed from adjacent masonry surfaces.

H. Upon completion of pointing, thoroughly rinse surfaces of walls at pointed areas to remove dust and other surface residue from pointing process. Use only very low pressure (less than 100 psi) water rinse. Rinse may be eliminated only with Architect approval.

3.06 FIELD QUALITY CONTROL

A. Mortar Testing
   1. At least two weeks prior to the start of masonry work, one set of at least nine cubes shall be taken from a batch of mortar prepared by the Contractor, in the presence of the testing laboratory personnel, with the materials to be used for the mortar during the masonry work, in accordance with ASTM C 780.
   2. One set of at least nine cubes shall be taken at a random day and time each week during the masonry work in accordance with ASTM C 780.
   3. Three cubes from each set shall be tested at three, seven, and twenty-eight days in accordance with ASTM C 270.
   4. The results achieved from the weekly sampling taken during the work will be expected to achieve results closely similar or better than that achieved from the set made prior to the start of masonry work.
   5. Composition of the mortar mix shall be tested once per week, throughout construction.

B. Field Inspection
   1. Inspectors: Architect shall review all work and prepare reports. Allow Architect full access to scaffolding and work areas, as needed to perform inspections, including 100% snorkle-lift access to facades for final inspection.
   2. Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency, as approved by the Owner and Architect as per Section 01410, to perform field tests and inspections indicated at Paragraph "A" above and prepare test reports:
      a. Payment for these services will be made by Contractor.
      b. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

3.07 CLEAN-UP

A. At the conclusion of masonry Work remove all equipment and surplus material used for mixing mortar, clean up all debris and refuse and remove same from the site.

END OF SECTION

SECTION 04 21 29 - TERRA COTTA RESTORATION (Alternate #1)

## PART 1 - GENERAL

### 1.01 WORK INCLUDED

A. Furnish all labor, materials, tools and equipment and perform all work necessary for and incidental to the restoration of terra cotta as shown on the Drawings and specified herein. This includes but is not limited to the following:
   1. Installing new anchors to secure cracked or loose, or those to be removed and reinstalled, terra cotta units shown on the Drawings.
   2. Installing patch material at selected locations as shown on the Drawings.
   3. Coating all spalled or missing areas of terra cotta glaze on units not indicated to be "replaced" or "patched" on Drawings.
   4. Installing new replacement terra cotta units where indicated.
   5. Removal of existing terra cotta coping units for installation of new metal through-wall flashing, and reinstalling/re-anchoring of same, at locations shown on Drawings. Number all such units and return to original position.
   6. Design and furnishing of all terra cotta anchorage per 1.04/E. and 2.03/A.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

1. Section 04 05 13 – Masonry Mortaring
2. Section 04 21 30 - Terra Cotta Fabrication
3. Section 04 43 00 – Stone Masonry
4. Section 04 01 20.52 – Unit Masonry Cleaning
5. Section 07 90 00 - Joint Protection

### 1.03 QUALITY ASSURANCE

A. Restoration Specialist: All repair work on the terra cotta shall be performed by a firm having demonstrated previous experience in the restoration of historic terra cotta and employing skilled workers for the execution of the Work.

B. Manufacturers: Materials shall be obtained only from manufacturers who will, if required, send a qualified technical representative to the Project site on an as-needed basis, at no additional cost to Owner, for the purpose of advising the Contractor of the procedures and precautions for the use of the materials. Certification of such field support must be submitted with manufacturer's submittals for approval.

### 1.04 SUBMITTALS AND MOCK-UPS

A. Submit manufacturer's specification and other product data for each proprietary product, including instructions for storage, handling, application and use. Include test data substantiating that products comply with requirements.

B. Test data that non-proprietary products and materials (e.g.) sand comply with specified requirements.

C. Material safety and Data Sheets.

D. Patching Material: Submit cured samples of patching material for patching terra cotta for approval of color and finish.

E. Sample:
1. Submit two samples of all anchoring devices proposed for use for repairing terra cotta.

F. Shop Drawings:
1. Submit shop drawings for new replacement units showing production details, construction of the terra cotta, dimensions, and relationships with adjacent construction in sufficient detail to cover manufacture, handling, and erection. Drawings shall show details of sections and connections for fastening each new terra cotta unit and shall identify anchorage, flashing (if indicated), and all accessories. Drawings shall be a minimum of 1/2 full scale.
2. Each replacement unit shall have a separate identification mark and shall be marked with the year of manufacture. Units shall be identified by this mark on shop drawings to show location of placement.

G. Structural Calculations: Terra cotta manufacturer shall submit structural calculations confirming the capacity of all proposed anchorage. Terra cotta manufacturers shall design and supply all anchorages, which shall be designed with a safety factor of four (4) by a structural engineer licensed in the State of Mississippi.

H. Mock-ups: Prepare the following mock-ups for review and approval by the Architect and the Owner prior to proceeding with the repairs. Areas where samples are to be performed shall be selected by the Owner and the Architect in consultation with the Contract Additional samples shall be prepared until an acceptable result is achieved. Completed approved samples will be incorporated into the completed work and shall be the standard for all work.
1. Four helical anchors and related crack repair in one terra cotta unit.
2. Repair of one deep spall at a terra cotta unit, including patching and coating.
3. Coating of glaze spalls, minimum six contiguous units in the field of the wall with significant glaze spalling. The mock-up shall include a range of coating colors for selection purposes.
4. Installation of each new replacement unit shall be performed as an individual start of work mock-up.

1.05 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Deliver materials to site in manufacturer's original and unopened containers and packaging, bearing labels as to type and names of products and manufacturers.

B. Protect materials during storage and construction. Keep containers tightly closed and away from damage. Protect liquid components from freezing. Comply with manufacturer’s recommendations for minimum and maximum temperature requirements for storage.

## PART 2 - PRODUCTS

### 2.01 HELICAL ANCHORS

A. Helical anchors shall be 8mm (5/16 inch) diameter Helifix Type 304 stainless steel anchors as manufactured by Helifix North America Corporation, Concord, Ontario, Canada, or approved equal.

### 2.02 GROUT

A. Grout for filling holes at locations of helical anchors, and for repair of cracks between 0.125 and 0.5 inch in width at locations indicated by Architect, shall be TA-650 sanded grout with Acrylic Latex Additive TA-869, as manufactured by TEC Specialty Products, Inc., Palatine, Illinois, an H.B. Fuller Company. For repair of cracks between 0.013 inch and 0.125 inch in width at locations indicated by Architect, grout shall be TA-620 unsanded grout and Acrylic Latex Additive AT-869, as manufactured by TEC, an H.B. Fuller Company.

B. Select grout in manufacturer's product colors to match adjacent terra cotta.

C. Follow manufacturer's recommended instructions and mixing proportions for the use of Acrylic Latex Additive.

### 2.03 STAINLESS STEEL DOWELS/TIES

A. Dowels and other anchorages for anchoring existing or replacement terra cotta units to existing parapets or other substrates shall be sized and furnished by terra cotta manufacturer, providing at a minimum the size and number of dowels shown on the Drawings. At details not indicating anchorage or terra cotta units, terra cotta replacement unit supplier (see Section 04525) shall design all anchorages for new or existing terra cotta units requiring installation in the existing masonry veneer.

### 2.04 PATCHING MATERIAL

A. Patch material for spalled areas of terra cotta bisque shall be Thoro Thoropatch, as manufactured by ChemRex/BASF, or approved equal.

### 2.05 COATING MATERIAL

A. Coating material for spalled or missing areas of terra cotta glaze shall be Thoro Thorosheen, 100 percent acrylic paint, as manufactured by ChemRex/BASF, or approved equal. Color to match terra cotta. Color to be determined by mock-up.

### 2.06 SEALANT

A. Sealant shall be as specified in Section 07900 – Sealants and shall match color of the adjacent terra cotta.

### 2.07 SASH CORD WICKING

A. Sash cord wicking of length required to produce 2" exposure on exterior of weep (for trimming at job completion).

2.08 OTHER MATERIALS

A. Mild, liquid detergent: for spot cleaning prior to implementation of repairs: Triton X-100 or approved equal.

PART 3 - EXECUTION

3.01 INSPECTION

A. Architect – Prior to start of work, provide access for Architect to inspect 100 percent of the terra cotta with the installer of the new terra cotta, to finalize repair quantities.

B. Installer - The installer shall examine all substrates, support and condition under which this Work is to be performed and notify Architect, in writing, of conditions detrimental to the proper completion of the Work. Do not proceed with Work until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.

B. The Contractor must designate an individual with commensurate experience to act as the "terra cotta foreman" to oversee all terra cotta restoration activities through the duration of the project.

C. Periodically through the course of repair work, the Architect may observe the work to verify compliance with the Contract Documents. At such time the Architect may designate additional repair items to be performed in compliance with the Contract Documents.

3.03 INSTALLATION OF REPLACEMENT UNITS AND REINSTALLATION OF SALVAGED UNITS

A. Before installation of new replacement units and existing units to be reinstalled, examine structural steel and masonry substrates that may be required to support terra cotta units. Examine the exposed steel for corrosion. If more than light corrosion is observed, notify Architect before proceeding. If determined by Architect to be necessary, proceed with repairs to steel members. Repair damaged masonry substrates before proceeding.

B. Installation of new terra cotta units and existing units to be reinstalled:
   1. Before proceeding, verify that the new units will fit properly in the prepared openings. Notify the Architect if there are discrepancies between the required sizes and the actual sizes of the replacement terra cotta units. Do not cut or modify terra cotta units without prior discussion with Architect. As directed, wait for instruction from Architect before proceeding with the installation.
   2. General installation:
      a. Prewet all terra cotta units prior to installation. The masonry must absorb all surface water. Adjacent masonry surfaces must be free of surface water.

b. Set replacement units in a full bed of mortar with both horizontal and vertical joints of same width as existing units.
c. Set replacement units true and plumb to match profile of adjacent units
d. Set units in place with shims and mortar.
e. Remove shims and fill joints with mortar. After mortar sets, grind back joints and repoint as specified in Section 04100.

3. Anchoring replacement units.
a. Secure replacement units with new anchors as shown in the approved shop drawings, based on terra cotta replacement unit supplier's calculations and recommendations.
b. Install anchors into sound substrate. Install in accordance with the anchor manufacturer's written instructions.
c. Install anchors as designed by manufacturers' structural engineer.

3.04 HELICAL ANCHOR INSTALLATION

A. Follow manufacturer's recommended procedure for "Dryfix" installation of helical anchors.

B. Drill undersized diameter hole according to manufacturer's instructions.

C. Insert helical anchor(s) using manufacturer's setting tool. Number of anchors as shown on the Drawings or as determined in the field following joint Architect/installer inspection. Countersink helical anchors minimum 1/4 inch.

D. Patch hole in terra cotta with grout. Finish the patch to match the profile and texture of the surrounding area.

E. Coat pin location with acrylic paint to match color of adjacent terra cotta, as described below. Do not apply paint to terra cotta glaze.

3.05 PATCH INSTALLATION

A. Remove broken or loose pieces of terra cotta to a sound surface.

B. Clean area to be patched with water and detergent. Prewet surface prior to application of cleaner. Apply liquid cleaner and scrub with soft bristled brush. Rinse thoroughly and allow to dry before installing patch.

C. Install stainless steel wire pins, as shown on the Drawings.

D. Mix and install patching material in accordance with manufacturer's recommendations. Install level and flush with adjacent terra cotta surfaces, as shown on the Drawings. Allow to cure.

E. Coat patch material with acrylic paint to match terra cotta glaze adjacent, as described below.

F. Do not apply patching material to adjacent areas of intact terra cotta.

3.06 COATING INSTALLATION

A. Remove loose and spalled terra cotta glaze.

B. Clean area to be coated with water and household detergent. Prewet surface prior to application of cleaner. Apply liquid cleaner and scrub with soft bristled brush. Rinse thoroughly and allow to dry before installing coating.

C. Install coating following manufacturer's recommended procedures.

D. Do not apply coating material to adjacent areas of intact terra cotta glaze.

3.07 CLEAN UP

A. At the conclusion of terra cotta restoration, remove all scaffolding and equipment used in the Work, clean up all debris, refuse and surplus materials and remove same from premises.

END OF SECTION

SECTION 04 21 30 - TERRA COTTA FABRICATION (Alternate #1)

## PART 1 - GENERAL

### 1.01 SUMMARY

A. Section includes providing new terra cotta as follows:
   1. Inspecting the existing terra cotta units to document each representative type of terra cotta unit.
   2. Custom glazes to match existing units.
   3. Measuring representative existing terra cotta units to be replaced.
   4. Using samples of existing terra cotta units as models for fabrication.
   5. Preparing shop drawings for new terra cotta units.
   6. Preparing appropriate molds to replicate existing terra cotta.
   7. Fabricating and delivering new terra cotta units to replace original/existing terra cotta units to be removed and/or demolished.

B. Terra cotta is supplied but not installed under this section. For installation, see Section 04520 - Terra Cotta Restoration.

C. Related Sections include the following:
   1. Section 04 21 29 - Terra Cotta Restoration

### 1.02 REFERENCES

A. Standards for terra cotta fabrication and testing:
   1. ASTM International (ASTM)
      a. ASTM C 67 – Standard Methods of Sampling and Testing Brick and Structural Clay Tile
      b. ASTM C 126 – Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units
      c. ASTM C 216 – Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)

### 1.03 SUBMITTALS

A. Production Schedule: Submit updated production schedule on biweekly basis, beginning with date of Agreement. Production schedule shall include dates for the following:
   1. Shop drawings submittal
   2. Glaze samples submittal
   3. Quality control samples submittal
   4. Testing prior to production
   5. Firing, by unit type, and related testing
   6. Shipping and delivery, by unit type, including production samples

B. Shop drawings:
   1. Submit shop drawings for review by the Architect. Drawings shall show production details, construction of the terra cotta, dimensions, and relationship in sufficient detail to cover manufacture, handling, and erection. Drawings shall show details of sections and connections for fastening the terra cotta units, shall identify anchorage and accessory items, and shall show relationship to adjacent, existing construction. Details shall be at least 1/2 full size. Shop drawings shall be sealed by a structural engineer, retained by the contractor, licensed in the State of Mississippi.
   2. Each replacement unit shall have a separate identification mark and shall be marked with the year of manufacture. Units shall be identified

by this identification mark on shop drawings to show location of replacement blocks for installation. Paint or stamp onto the terra cotta material identification marks on back of replacement blocks in an appropriate location.

C. Material Samples (prior to production):
   1. Glaze samples:
      a. Submit for approval four samples of glazed terra cotta for each glaze type and color, covering expected range of color and texture of surface finish to match original finish. Colors shall match the cleaned terra cotta units. Cleaning shall be as specified in Section 04930 - Masonry Cleaning, or as directed by Architect for sampling purposes.
      b. Each glaze sample shall be not less than 6 inches by 6 inches in size.
      c. Repeat sample submittals until acceptable match is achieved.
   2. Terra cotta samples:
      a. Upon approval of glaze samples, submit three samples of terra cotta for approval, using approved glaze.
      b. Samples shall be representative of typical reproduction units for this project, and shall each be a complete and intact unit. Accepted samples shall be stored at the job site for reference. These samples shall be separate from testing samples.
      c. Repeat sample submittals if samples do not meet requirements of testing program.
   3. Samples selected and approved by Architect shall be the standard for reproduction units.

D. Submit manufacturer's specifications and installation instructions for each item of proprietary material used, showing compliance with its use.

E. Submit a sample of the terra cotta warranty offered by the manufacturer.

F. Submit a letter from the terra cotta manufacturer stating that the drawings have been reviewed and that their terra cotta is suitable for the intended use.

G. Test Reports
   1. Test terra cotta prior to production and after each firing. Submit test reports from approved testing laboratory showing conformance of the new terra cotta to the physical test requirements set forth in this Specification. Each test shall be done on 5 different blocks of each type (hand formed, ram pressed and extruded.)
   2. Samples shall be tested for the following properties in accordance with ASTM C 67, except as noted:
      a. 24 hour cold water absorption
      b. 5 hour boil absorption
      c. Saturation coefficient
      d. Initial rate of absorption (suction)
      e. Efflorescence
      f. Crazing (ASTM C126)
      g. Imperviousness (ASTM C126)
      h. Chemical Resistance (ASTM C126)
   3. If any one unit submitted for testing does not meet the specification, two additional samples from that firing shall be tested. If both samples pass, the terra cotta from that firing shall be accepted. If one or both still fails to meet the specification, the terra cotta from that firing will be rejected.
   4. Testing laboratory shall be approved by Architect.
   5. Costs for all testing and any re-testing shall be borne by the Contractor.

1.04 QUALITY ASSURANCE

A. Manufacturers:
   1. Manufacturers shall send a qualified technical representative to the project site for the purpose of surveying and measuring each terra cotta unit to be replaced and advising the installer of the procedures and precautions for the use of the material.
   2. Terra cotta shall be the product of an established specialty plant having the capacity and facilities for producing material of specified quality and finish, and in sufficient quantity so as to not delay progress of the work. The plant shall be that of a producer recognized by the industry as a manufacturer of this type of material, who can show successful completion of work of comparable quality and scope.

B. Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 for testing indicated.

C. Except as modified by the project specifications, cited reference standards or applicable portions thereof shall govern the work.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle material to prevent deterioration or the intrusion of any foreign matter. Packaged material shall be delivered and stored in the original packages. Materials in broken packages or showing evidence of damage will be rejected.

B. Store material in such a manner as to damage or place undue stress on the existing structure or the roof membrane of the building.

C. Take the necessary precautions to ascertain that the following conditions are met:
   1. Store terra cotta or brick off ground to prevent contamination by mud, dust or materials likely to interfere with the bond of the mortar used in construction or cause staining or other defects.
   2. Protect materials from elements and neglect.

## PART TWO - PRODUCTS

1.06 MANUFACTURERS

A. Boston Valley Terra Cotta: 6860 South Abbott Road, Orchard Park, New York 14127, phone (716) 649-7490.

B. Gladding McBean: 601 7th Street, Lincoln, California 95648, phone: (800) 776-1133.

1.07 MATERIAL

A. Terra Cotta
   1. Surface Features: Match color, texture, shape, size, and profiles of existing cleaned units.
   2. Compressive Strength: minimum 6,000 psi.
   3. Absorption: maximum 7.4 percent during a 24-hour cold water absorption test and maximum saturation coefficient of 0.65 with no more than one unit in five having a saturation coefficient greater than or equal to 0.70, when tested in accordance with ASTM C 67.
   4. Initial Rate of Absorption: Initial rate of absorption shall not be less than 5 grams/minute/30 sq. in. and not greater than 20 grams/minute/30 sq. in. when tested in accordance with ASTM C67. The

variation in initial rate of absorption between units tested shall not exceed 15 percent.

5. Efflorescence: Terra cotta shall be rated "not effloresced" when tested in accordance with ASTM C67.
6. Crazing Resistance: Glaze shall not craze when submitted to Autoclave Crazing Test of ASTM C 126, Section 16. The glaze shall be further inspected at a magnification of at least 10X. Units that show microscopic crazing, where the crazing does not penetrate to the bisque, shall be accepted. Where even microscopic crazing penetrates to the bisque, the terra cotta shall be rejected unless the crazed material passes the Glaze Permeability Test, the crazed material still visually matches the previously accepted samples, and the appearance is not considered visually objectionable. This test does not apply to unglazed units.
7. Imperviousness: No stain that can be seen from a distance of 5 feet shall remain on or beneath the surface when subjected to the Imperviousness Test of ASTM C126, Section 16. This test does not apply to unglazed units.
8. Chemical Resistance: The color of the glaze shall not change when subjected to the Chemical Resistance Test of ASTM C126, Section 16. This test does not apply to unglazed units.

1.08 DESIGN

A. Design terra cotta pieces to satisfy the performance requirements specified herein.

B. Pieces shall be structurally sound with adequate provision for anchorage and setting.
   1. Extruded flat panels: Thin, solid slabs with scored or ribbed backs, minimum 1-1/4 inches thick
   2. Ornamental and specialty shapes:
      a. Exposed faces: 1-1/2 inches thick minimum
      b. Webs: Thickness and spacing to provide required structural support - minimum thickness of 1-1/4 inch.
      c. Beds: 4 inches deep minimum

C. Provide required anchor and hand holes. Hole locations and sizes must be coordinated between the manufacturer and the designer of the anchorage.

D. Provide projecting or overhanging pieces with drips.

E. Provide weepholes in the bottoms of hung units.

1.09 FABRICATION

A. Do not proceed with fabrication of terra cotta prior to approval of shop drawings and samples.

B. Duplicate existing terra cotta pieces based on representative samples from the building. Produce molds for forming terra cotta pieces. Allow for clay shrinkage during drying and firing. Dimension units so they can be set with uniform joints; joint widths to match original. Provide for expected thermal and moisture expansion.

C. Form clay pieces by hand pressing, ram pressing, or extruding as determined by manufacturer as best method for shapes, sizes, and complexity of terra cotta.

D. Fabrication Tolerances:

1. Verify that dimensions comply with approved shop drawings. In cases where individual pieces delivered to the project require field cutting to achieve required size, cutting may be performed with diamond tipped blade but shall be reviewed on a case-by-case basis with the Architect.
2. Tolerances:
   a. Face dimensions: Exposed face of each unit shall not vary more than 1/16 inch plus or minus the dimensions shown on shop drawings.
   b. Warpage: Exposed face of terra cotta shall not vary from true plane more than stable original existing terra cotta in place.

1.10 FINISHES

A. Finished faces shall be free from crazing, blisters, pinholes, crawling,staining, chipping, or other imperfections in accordance with ASTM C 126 or which detract from the appearance of the unit when viewed from a distance of five feet.

B. Color, texture, and reflectivity of glazed and unglazed pieces to match approved samples.

C. Conform to ASTM C 126, Section 6 – Properties of Finish.

## PART 3 - EXECUTION

1.11 SITE SURVEY

A. Conduct site survey of existing building prior to submittal of shop drawings and fabrication of terra cotta pieces. Be responsible to gather information and record data as necessary to accurately fabricate the replacement units.

B. Identify and code each piece to be replaced, including variations (size and otherwise) of similar units.

C. Representative samples:
   1. Remove existing terra cotta pieces as required for samples to use in preparation of molds for fabrication of replacement pieces.
   2. Pack, crate, and deliver samples to manufacturer’s plant.
   3. Provide temporary protection to prevent moisture penetration into the wall where terra cotta pieces are removed.
   4. Clean units to allow for color match.

1.12 REPLACEMENT AND INSTALLATION

A. Refer to Section 04 21 29 - Terra Cotta Restoration.

END OF SECTION

SECTION 04 43 00 - STONE MASONRY (Alternate #1)

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Work Included:
   1. Fabricate and install new limestone to match original units where indicated on the Drawings.
   2. Repair of spalled, delaminated, or cracked stone with new dutchman units to match original stone.
   3. Pinning cracked portions of stone masonry.
   4. Grouting cracks in stone masonry.

B. Related Sections:
   1. Section 04 05 13 – Masonry Mortaring
   2. Section 04 21 29 - Terra Cotta Restoration
   3. Section 04 01 20.52 – Unit Masonry Cleaning
   4. Section 07 90 00 – Joint Protection

### 1.2 DEFINITIONS

A. Chip — an irregularly-shaped piece of stone, usually with one convex surface, that has been dislodged from a snip.
B. Pits — small depressions, voids or pinholes in stone, especially on a finished surface.
C. Snip — the concave surface from which a chip has been dislodged.
D. Spalls — fragments or chips from a piece of stone.

### 1.3 REFERENCES

A. American Institute of Steel Construction (AISC)

B. Indiana Limestone Institute of America, Inc. Handbook

C. National Building Granite Quarries Association (NBGQA) Specifications for Architectural Granite

D. American Society for Testing and Materials (ASTM)

   1. A 167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
   2. A276 - Standard Specification for Stainless Steel Bars and Shapes
   3. A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
   4. C119 - Standard Terminology Relating to Dimension Stone
   5. C170 - Test Method for Compressive Strength of Dimension Stone
   6. C615 - Specification for Granite Dimension Stone
   7. C568 - Standard Specification for Limestone Dimension Stone

8. C880 - Test Method for Flexural Strength of Dimensional Stone
9. F593-02 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for application and use. Include test data substantiating that products comply with requirements.

B. Qualification Data: For masonry contractor, field supervisors, and stone masons.

C. Literature
1. Technical literature on stone repair materials describing material properties, storage and handling, installation procedures, and testing requirements of manufacturer.
2. MSDS sheets for specified products.
3. Sample manufacturer standard and extended warranties.
4. Stone manufacturer's literature and test results certifying that stone to be supplied has the specified minimum properties. Test results must not be older than 2 years.

D. Stone Samples for Color Selection: Submit not less than five fabricator's standard tiles for color selection, showing a range of colors meeting the requirements of this section and closely matching the existing appearance of the stone on the building, for selection of a particular stone type by the Architect. Existing stone shall be cleaned in areas used for matching.

E. Shop drawings for replacement or repair stone: include contextual stone layout, dimensions, and anchorage as designed and furnished by stone supplier.

1.5 QUALITY ASSURANCE

A. Comply with provisions, references documents, and standards listed in specification unless otherwise noted.

B. Project Team Requirements
1. Contractor: Must have a minimum of 5 years experience in construction and supervision of stone repair work.
2. Stone Masons: Minimum of 5 years experience in Stone Repair.

C. Source Limitations: Obtain each type of material for stone restoration (stone, cement, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical properties.

D. Quality Control
   1. Mockups
      a. At the trial repair areas designated by the Owner and Architect, perform representative sample repairs at locations selected by Architect and Owner to illustrate the type and quality of the Work required to satisfy the requirements of the Project. The approved sample repair is the standard of quality for the remainder of Project.
      b. Mockups shall include at least one repair location of each repair type depicted on the Drawings.
      c. For repair mortar match the adjacent stone in color, texture, composition, texture, particle size and appearance.
      d. Provide additional samples until results acceptable to the Architect are achieved.
      e. Commence work only after each sample repair has been reviewed and accepted by Architect and Owner.
      f. Retain samples throughout the duration of the project as references for the work and upon completion incorporate samples into the work.
      g. Install samples using same personnel as those throughout project.
   2. Allow Architect to inspect stone panels, rebates, kerfs and dowel holes of panels prior to installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery
   1. Deliver, store, and handle materials to prevent deterioration or the intrusion of foreign matter. Deliver and store packaged materials in the original packages. Removed from the jobsite damaged or otherwise unsuitable material.
   2. Deliver materials to site in manufacturer's original and unopened containers and packaging, bearing labels as to type and names of products and manufacturers.
   3. Do not use materials in broken packages or which show evidence of damage.
   4. Notify the Architect and the Owner of damage observed to existing and salvaged stone pieces prior to commencing work.

B. Storage

   1. Verify adequacy of support or portion of the structure for loading with equipment and materials. Storage of large amounts of stone and other materials on the roof or within the attic structure is not permitted.
   2. Store stone sections clear of the ground on non-staining skids (cypress, white pine, poplar, or yellow pine without an excessive amount of resin). Do not use chemically treated wood. DO NOT use

chestnut, walnut, oak, fir, and other woods containing tannin or other substances that may stain the stone.

3. Store stone above grade on wood or other suitable surfaces using polyethylene film to separate stone from wood or other supporting or protecting members.
4. Store limestone in accordance with recommendations presented in the Indiana Limestone Institute of America, Inc. Handbook.
5. Protect materials during storage and construction. Keep containers tightly closed and away from damage. Protect liquid components from freezing. Comply with manufacturer's recommendations for minimum and maximum temperature requirements for storage.
6. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.7 PROJECT CONDITIONS

A. Cold-Weather Requirements: Comply with the following procedures for stone repair and patching:
   1. When air temperature is below 40 deg F, heat mortar ingredients, repair materials, and existing stone to produce temperatures between 40 and 120 deg F.
   2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for 7 days after repairs using products damaged by freezing.

B. Hot-Weather Requirements: Protect masonry repair and mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar and patching materials. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply cement based products to substrates with temperatures of 90 deg F and above.

C. Patch stone only when air and surface temperatures are between and 55 and 100 deg F and are predicted to remain above 55 deg F for at least 7 days after completion of work. On days when air temperature is predicted to go above 90 deg F, schedule patching work to coincide with time that surface being patched will be in shade or during cooler morning hours.

D. Examine facade elements, substrates, support and condition under which the Work is to be performed and notify the Architect of conditions detrimental to the proper completion of the Work. Where conditions are uncovered that are not anticipated by the Drawings and Specifications, notify the Owner and Architect immediately before repairs are initiated. Proceeding with repairs at these locations

without description from the Engineer is entirely at the risk and cost of the Contractor.

E. Precautions
1. Apply epoxies only to dry surfaces meeting the manufacturer's recommendations for surface preparation and working temperatures.
2. Apply epoxies to surfaces free of moisture, dirt, organic materials, efflorescent salts, and other contaminants.

F. Protection of Work
1. Temporarily mask stones, as required, to prevent repair materials from staining stone and existing or new materials in and adjacent to the area of Work. Immediately clean exterior wall system and adjacent areas of spilled materials.
2. Cover partially completed anchors, cracks and joints that are not sealed at the end of each working day or shutdown or when work is not in progress.
3. Extend cover beyond each side of partially completed anchors, cracks and joints to prevent exposure to weather.
4. Secure cover tightly in place.
5. Cover exterior wall openings to prevent infiltration of animals, insects, and water during stone removal.
6. Cover partially completed work at the end of each working day or when work is not in progress.
7. Carefully cover tops and sides of incomplete areas when construction is discontinued at end of work day, to protect are from precipitation. Protect joints in stonework to make them watertight until they are permanently repaired.

G. Shore surrounding stone or other masonry as necessary to prevent shifting or collapse during removal and replacement of stone units or portions thereof.

## PART 2 - PRODUCTS

### 2.1 STONE

A. Limestone: Indiana limestone as quarried in south central Indiana.
1. Match the color, finish, appearance, and thickness of existing stone on building.
2. Stone shall meet the requirements of ASTM C 568 Standard Specification for Limestone Dimension Stone for medium density limestone, except minimum modulus of rupture shall be 700 psi.
3. Maximum coefficient of thermal expansion = 0.000003 in./in. deg. F.
4. Minimum ultimate shear strength = 900 psi.
5. Limestone Grade: select

## 2.2 HARDWARE

A. General
   1. Metal in direct contact with stone is to be non-corrosive.

B. Stone Anchors

   1. Stone anchors: stainless steel conforming with ASTM A 167, Type 304
   2. Anchor embedment depth and countersink dimension as shown on Drawings
   3. Helical Anchors:
      a. Dry Fix, 8mm as manufactured by Helifix North America Corporation, Concord, Ontario.
   4. Dowels:
      a. Spring-loaded Dowels: Heckmann #355, stainless steel.
      b. Standard Dowels: Heckmann #155, Type 304 stainless steel, size as indicated.

C. Miscellaneous Hardware
   1. Reinforcement of patches: helical anchors; stainless steel hooked pins, 1/8 inch diameter; or stainless steel wire mesh. Stainless steel to conform with ASTM A 167, Type 304.
   2. Shims: thickness as required; material:
      a. High Density Polyethylene
      b. Lead
      c. Wood shims, if used to temporarily align or support the work, shall be removed prior to completion of the work
      d. Plastic horseshoe shaped shims shall not be used

## 2.3 ADHESIVE MATERIALS

A. Stone-to-Stone Adhesive, for use in small quantities for setting dutchman units prior to installation of new pins or anchors anchors: 1-part cementitious stone adhesive, recommended by adhesive manufacturer for type of stone repair indicated, and matching stone color.

   1. One-Part Cementitious Stone Adhesive:
      a. Edison Coatings, Inc., Custom System 45.
      b. Bonstone Materials, Inc., Last Patch Limestone.

## 2.4 CRACK REPAIR GROUT

A. Grout to repair cracks between 0.013 inch and 0.125 inch in width shall be made using TA-620 unsanded grout and Acrylic Latex Additive AT-869, as manufactured by TEC, an H.B. Fuller Company.

B. Grout to repair cracks between 0.125 and 0.5 inch in width shall be made using TA-650 sanded grout and Acrylic Latex Additive TA-869, as manufactured by TEC, an H.B. Fuller Company.

C. Select grout in manufacturer's product colors to match existing precast units.

2.5 WATER

A. Clean, potable water. Water used for prewetting, mixing, and rinsing must have an iron content of less than two (2) parts per million, or 0.0002 percent (by weight). Water to be used shall be sampled and tested for iron content prior to beginning work.

2.6 SPECIAL EQUIPMENT

A. Drill for anchor installation holes into stone shall be high speed, rotary percussion drill (3 jaw chuck type). SDS hammer drills (e.g. Hilti hammer drill) shall not be used for drilling anchor installation holes.

B. Coring drill with diamond core bits.

## PART 3 - EXECUTION

3.1 PRECONSTRUCTION ARCHITECT SURVEY

A. Provide close up access to Architect for inspection of building facade at beginning of project so as to further refine locations and repair types, prior to providing shop drawings/submittals.

B. Architect shall confirm repair types and locations at each location.

3.2 GENERAL

A. Install stone plumb, square, and true to line.
   1. Setting Tolerances: Install patches and new and salvaged stone units to maintain existing alignment of stone and original decorative profiles.

B. Install stone free of dust and debris.

C. Isolate dissimilar metals.

D. Drill holes in stone without spalling or cracking unit at hole, using only rotary percussion drill. If needed, pre-drill dutchman pieces with oversize anchorage hole prior to setting.

E. Allow opportunity for required inspection of Work before permanently covering or concealing elements of Work.

F. Where embedded steel structural elements, e.g. window lintels, are exposed during the work:

1. Examined exposed structural steel (if any) at location of removed unit. Notify Architect if heavy build-up of corrosion or significant section loss is observed.
2. Clean, prime, and paint the exposed steel with rust-inhibitive coating system specified in Section 04510. Prepare steel and apply coatings in accordance with coating manufacturer's recommendations. Protect face of stone and adjacent materials from coatings.

G. Where embedded steel non-structural elements, are exposed during the work, allow for inspection by Architect before proceeding with stone work.

## 3.3 INSTALLATION OF FULL THICKNESS STONE UNIT

A. Removal of previous material
1. Cut along mortar joints around the unit or patching material to be removed.
2. Remove materials without damaging adjacent sound stone units.
3. Remove all mortar from the joints around the removal areas.

B. Fabricate new stone unit to match color and texture of adjacent stone.

1. Stone unit shall be cut straight and square, or otherwise as required, to match the dimensions of the prepared removal area.
2. Stone unit shall exactly match carved decorative profile of adjacent stone.
3. All exposed surfaces of stone unit shall be dressed to match original stone finish.
4. Include notches, rabbets, and dowel holes as needed to accommodate new anchorage.

C. Anchor installation

1. Inspect backup masonry and repoint brick or terra cotta back-up as specified in Section 04 21 29 to provide a suitable substrate.
2. Carefully drill dowel holes into adjacent intact stone units as shown on the Drawings.
3. Install clip angles into sound backup masonry.
4. Install dowels and temporarily hold clear of opening.

D. Installation

1. Neoprene shims may be used to align panels to match adjacent panels and create joints between panels.

2. Set limestone units to be reset in full bed of mortar.
3. All limestone units shall be installed plumb, square and true to line.
4. When stone unit is in final position, drop or spring dowels into place to secure unit.

E. Install and set all limestone units with head and bed joints completely filled with mortar. After mortar achieves its initial set, rake all mortar joints back 3/4 inch minimum, and repoint repair area at same time as rest of building facade.

3.4 DUTCHMAN REPAIR

A. At locations designated for repair, cut out immediate area of spall, any previous patching materials, and adjacent unsound stone to form a rectangular opening, to full depth of stone unit. Confirm geometry of repair with Architect before proceeding.

B. Fabricate stone dutchman unit to match color and texture of adjacent stone.
1. Dutchman shall be cut straight and square to match the dimensions of the prepared removal area.
2. Dutchman shall exactly match carved decorative profile of adjacent stone.
3. All exposed surfaces of dutchman shall be dressed to match original stone finish.

C. Set dutchman unit in cementitious adhesive. Once mortar has set, anchor dutchman unit with stainless steel dowels and strap anchors as shown on Drawings and described above. Minimize width of joint between dutchman and original portion of stone unit a maximum of 1/8 inch.

D. Grout perimeter joint with specified grout material or mortar and carefully clean excess mortar and grout from exposed stone surfaces.

E. Where dutchman units adjoin mortar joints, install dutchman unit so as to maintain joint size. Keep joint clear of debris. After dutchman unit is complete, fill joint with mortar and repointing as specified, or install backer rod and sealant at joints indicated.

3.5 THROUGH-FACE HELICAL ANCHOR

A. Install anchors at locations indicated on the Drawings or as directed by Architect in the field after 100 percent inspection.

B. Do not place holes for anchors at or within 1-1/2 inches of existing voids, heavy veins, cracks, or edges of stone pieces. Take necessary precautions to ensure that spalls or other distress do not occur

during stone drilling or anchor installation operations. Notify Architect if distress occurs during drilling.

C. At each anchor location, carefully drill a pilot hole through stone panel and into backup wall at angle and embedment depth specified in Drawings. When drilling pilot hole, a rotary percussion drill should be used to reduce risk of stone spalling or cracking during drilling operations.
   1. Diameter of pilot hole as recommended by manufacturer.

D. Insert helical anchor using manufacturer's setting tool.

E. Countersink anchor to 1/8 inch beyond surface of stone.

F. Install grout in hole over anchor with specified grout material and in accordance with material manufacturer's instructions and recommendations.

## 3.6 ISOLATED CRACK REPAIR AT LIMESTONE PANELS

A. General:
   1. Leave cracks less than 0.013 inch in width unrepaired.
   2. Repair cracks between 0.013 inch and 0.125 inch in width with unsanded grout.
   3. Repair cracks greater than 0.125 inch and up to 0.5 inch in width with sanded grout.

B. Preparation of cracks:
   1. Remove any existing material in existing crack. For cracks greater than 0.125 inch, cut out crack to a depth at least as wide as the crack. Clean out existing material and debris but do not widen cracks.
   2. Remove all loose material and dust with oil-free compressed air and a brush.
   3. Do not damage adjacent material during preparation of cracks for repair.

C. Grouting of cracks:
   1. Prepare grout for crack repair in accordance with manufacturer's recommendations.
   2. Dampen the joint to be grouted prior to grouting. The concrete must absorb all surface water.
   3. Pack the grout tightly into the joint in thin layers of 1/4 inch maximum layer thickness. Allow each layer to become thumbprint dry before applying next layer.
   4. Tool grout in crack to a flat profile, flush with adjacent concrete.
   5. Wipe excess grout from surface adjacent to crack with damp sponge or cloth. Use only sponge or cloth that is damp, not wet or

saturated. When tightly squeezed; water will not run from damp sponge or cloth. Surface shall not have visible accumulation of water immediately after cleaning. Do not touch or disturb newly installed grout during cleaning. Clean until grout is removed from adjacent surfaces.

6. Cover crack and area extending 2 inches past crack with Kraft paper. Secure Kraft paper to surface with tape that will not stain or leave adhesive on concrete or adjacent material. Do not adhere tape to window or curtain wall components or glazing. Keep Kraft paper over crack for 24 hours.

## 3.7 FINISHING AND CLEAN UP

A. Where mortar joints occur adjacent to stone repairs, point joints in accordance with Section 04510 after completing all repair work.

B. At conclusion of stone work, remove scaffolding and equipment used in work, clean up debris, refuse and surplus material and remove same from premises.

C. After stone repair work is completed and joints are sealed, stone work shall be washed with fiber brushes, and clean water (wash with water and brushed with fiber brushes to remove construction debris).

## 3.8 FIELD QUALITY CONTROL

A. Architect’s Project Representatives: Architect will assign Project representatives to help carry out Architect’s responsibilities at site, including observing progress and quality of portion of Work completed. Allow Architect’s Project representatives use of scaffolding, as needed, to observe progress and quality of portion of Work completed.

B. Notify Architect’s Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until have had reasonable opportunity to make of work areas at lift device or scaffold location.

END OF SECTION

SECTION 05 50 00 – MISCELLANEOUS METALS AND FABRICATIONS

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Provide all fabrications and miscellaneous metal work, with all accessories, and other related items necessary to complete the Work indicated on the Drawings and specified herein. Work includes interior miscellaneous metals.

B. Related work specified elsewhere:
   1. Section 06 01 20 - Finish Carpentry and Millwork

### 1.02 SUBMITTALS

A. Prepare shop drawings for all miscellaneous metals and fabrications before fabrication is begun and submit to the Architect for approval. Show all details required for fabrication and erection. Obtain Architect's approval prior to fabrication.

### 1.03 STANDARDS

A. Comply with requirements and recommendations of applicable portions of Standards as published by the following:
   1. American Institute of Steel Construction (AISC).
   2. American Society for Testing and Materials (ASTM).
   3. American Welding Society (AWS).
   4. Steel Structures Painting Council (SSPC).

### 1.04 QUALITY CONTROL

A. Welders shall be certified within the previous 12 months as qualified operators according to requirements of the American Welding Society, with copies of certificates furnished to the Architect.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

A. Miscellaneous Steel for Fabrication: Provide rectangular and square tubing, solid bars, and angles of shapes and sizes shown on Drawings. Permissible tolerances for out-of-square or out-of-parallel, depth, width, and symmetry of rolled shapes shall conform to ASTM Specification A6. Overall profile dimensions of built-up members shall be adequate to provide for the accumulated permissible overrun of the component parts. The as-fabricated straightness tolerances of members shall not exceed ½ of the standard camber and sweep tolerances in ASTM A6.

B. Steel Pipe: ASTM A53, Schedule 40.

C. Steel Tubing: ASTM A513, 1010 structural grade.

D. Malleable Iron Castings: ASTM A47.

E. Anchor Bolts: ASTM A-307.

F. Paints:

1. Shop primer and touch-up for exterior steel - Insl-x CheckRust Universal Primer MP-9000 (Phenolic Alkyd).
   a. No substitution to be allowed. This primer must be compatible with the field-applied paint top-coats specified in Section 09900.

G. Electrodes: AWS A5.1, or A5.5, E70XX.

2.02 ROUGH HARDWARE

A. Shall include all bolts, screws, anchors, expansion shields, hangers, fasteners, etc., necessary for the completion of the construction.

B. Fasteners: Provide stainless steel for exterior use and where built into walls, and as follows:

1. Bolts and Nuts: ASTM A325, 3/4" diameter for bolted structural connections.
2. Masonry and Concrete Anchorage Devises: Expansion anchors, Federal Specifications FF-S-325, Group II, Type 4, Class 1. Equal to Hilti Fastening Systems "Super Kwik Bolt", with two sets of expansion wedges, stainless steel.

2.03 STAINLESS STEEL TUBING (AT MILLWORK APPLICATIONS)

A. Restroom vanities: Equal to Julius Blum stainless steel tubing 4” x 1-3/4”x 0.062”, or other size noted on Drawings. Tube members shall be either shop or field “brushed” to remove all stridations, oils, etc. from exposed surfaces.

2.04 MISCELLANEOUS STEEL FRAMING AND SUPPORT

A. Fabricate and erect as shown on Drawings.

2.05 STACKED STEEL PLATE (AT GARDEN ROM 1201)

A. Fabricate of flate plate as shown on Drawings (9/6.0, 17/6.0).

2.06 STEEL TUBE COUNTERTOP BRACES (BALLROOM 1200)

A. Fabricate of 2” x 2” x 1/4” steel tube as shown on Drawings (8/7.0).

2.07 HAND RAIL AT BALLROOM

A. Steel Handrail Posts: 1”x1” solid steel bar, typical, and 1-1/4” x 1-1/4” bar at end post conditions, unless shown otherwise on Drawings.

B. Bronze Rail Caps at Handrails: Equal to Julius Blum #4534 mill finish bronze alloy C38500, to be cleaned and clear lacquered by fabricator to match fittings. Substructure to be ½” x 1-1/4” steel flat bar, to be painted.

C. Bronze Fittings End of Handrails: Equal to Julius Blum #4534N, square end piece.

D. Wall Brackets: Shop-fabricated steel, as detailed on Drawings.

2.08 PREPARATION OF STEEL PRIOR TO GALVANIZING

A. Surface preparation of all fabricated steel and miscellaneous metals shall be as follows:
   1. Oil and grease shall be removed, using solvent cleaning methods, in accordance with SSPC-SP1, "Solvent Cleaning".
   2. Millscale, rust and other contaminants shall be removed, using abrasive blast methods, in accordance with SSPC-SP6, "Commercial Blast Cleaning".
   3. All shop welds shall be cleaned in accordance with SSPC-SP11, "Power Tool Cleaning to Bare Metal".

2.09 GALVANIZING

A. All components or assembles indicated on the Drawings or in the Specifications as galvanized shall receive a zinc coating through the hot-dipped galvanized process.

B. Reference standards for hot-dipped galvanizing are as follows:
   1. Specification for Zinc Coatings on Iron and Steel – ASTM, A123A 123M-97a$^{e1}$.
   2. Specification for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies - ASTM, A384-76 (Re-approved 1996).
   3. Providing High Quality Zinc Coatings - ASTM A385-98.
   4. Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings, ASTM A780-93a.

C. Coating Thickness: Standard exposed architectural steel to conform to the minimum requirements of ASTM G90. Minimum thickness equal to 90 oz/sf.

## PART 3 - EXECUTION

3.01 PREPARATION

A. Supply drawings and details for items required to be cast into concrete or embedded in masonry.

3.02 FABRICATION AND ERECTION

A. Do not deliver materials to the jobsite until conditions are ready for installation. Handle materials in a manner to avoid damage to members and finish. Store materials off-ground in a protected area.

B. Fabricate and erect according to the latest requirements of the American Institute of Steel Construction. Welding shall be according to the requirements of American Welding Society.

C. Fabrications shall be erected square, straight, and plumb with tight fitting joints and intersections.

D. Field weld components indicated on shop drawings. Perform field welding in accordance with AWS D1.1.

E. All exposed steel fabrications shall have all joints welded continuous.

All welds shall be ground and polished smooth. The welding, grinding and polishing operations shall completely eliminate the visual butt joints between members that have radiused edges.

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

G. Fabrication shall be performed with special care and necessary straightening to maintain the condition of material as described at 2.01, A.

H. All copes, miters, and butt cuts in surfaces exposed to view shall be made with uniform contact. Components in an assembly shall fit together tightly and welded on all sides.

I. Fillet welds: Faces of welds exposed to view shall have as-welded surfaces that are smooth and uniform in grain. Welds shall be even in dimension, free of slag, and sharp ridges. If a weld quality is poor, finishing or grinding shall be required.

J. Butt and plug welds: Faces of butt and plug welds exposed to view shall be ground smooth to the face of metal to create a smooth, even surface with no appearance of a joint.

K. Shop cleaning: After fabrication each component and all joints shall be inspected for conformance to quality standards, and all nonconforming work shall be corrected. While in shop all steel shall be cleaned of all slag, mill scale, rust, oil, moisture, and dirt as per the Steel Structures Painting Council’s Specification SP-6.

L. Painting: After steel clean down, apply one coat of shop primer to dry surfaces by brush, spray, roller, or dipping.

END OF SECTION

0SECTION 06 01 10 - ROUGH CARPENTRY

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Furnish labor, materials, equipment, services and supervision necessary and reasonably incidental to complete items of rough carpentry indicated on the Drawings and specified herein.

B. Related work specified elsewhere:
   1. Section 05540 – Miscellaneous Metals and Fabrications
   2. Section 06200 – Finished Carpentry and Millwork
   3. Section 09250 – Gypsum Board Systems

### 1.02 QUALITY ASSURANCE

A. Lumber shall conform to American Softwood Lumber Standards PS 20-70, of the U.S. Department of Commerce, and to the grading rules of the following associations as applicable:
   1. Southern Pine Inspection Bureau (SPIB).
   2. West Coast Lumber Inspection Bureau (WCLIB).
   3. Western Wood Products Association (WWPA).
   4. National Lumber Grades Authority (NLGA).

B. Plywood grading rules shall conform to Product Standards PS 1-83.

C. Plywood shall bear the grade mark of American Plywood Association (APA).

D. Identify all wood products with appropriate grade marks on each piece.

### 1.03 PROTECTION

A. Lumber products shall be protected from the elements by being stacked on supports at least 6" above ground and then being covered with waterproof building paper. Lumber products shall not be delivered to the site unduly long before they are to be used in the work.

## PART 2 - PRODUCTS

### 2.01 LUMBER

A. Use dressed (S4S) lumber unless otherwise indicated.

B. Southern Pine lumber shall be kiln-dried (KD) to a maximum moisture content of 15%. Pressure-treated lumber shall be re-dried after treatment to a maximum moisture content of 15%. Each piece shall be stamped either "KD" or "MC15".

C. Western Spruce-Pine-Fir lumber shall be kiln-dried to a moisture content of 19% or less. Each piece shall be stamped "S-DRY".

D. Lumber and blocking at new construction shall be sizes or conditions noted on Drawings; lumber at restoration construction shall match sizes of lumber being repaired or replaced.

2.02 PRESERVATIVE TREATMENT

A. Preservative pressure treated lumber is required at the following locations:
   1. All lumber and framing in contact with concrete or masonry.
   2. Elsewhere as indicated on Drawings.

B. Preservative pressure treated lumber and plywood shall receive a waterborne pressure treatment of Inorganic Boron (SBX) for lumber and Chromated Copper Arsenate (CCA) for plywood, applied in a closed cylinder by vacuum-pressure process in accordance with American Wood-Preservers' Association (AWPA) Commodity Standards C2 and C9.
   1. Treated wood products shall conform to requirements of AWPA Use Category Designations UC1, UC2, UC3A, and UC3B (above ground use).
   2. Preservative pressure treatment of lumber shall comply with AWPA Commodity Specification A for Commodity standard C2.
   3. Preservative pressure treatment of plywood shall comply with AWPA Commodity Specification F for Commodity Standard C9.
   4. The retention of preservative shall not be less than the following:
      a. Lumber: Inorganic Boron (SBX) - 0.28 lbs./cubic foot of wood.
      b. Plywood: Chromated Copper Arsenate (CCA) – 0.25 lbs./cubic foot of wood

2.04 STAINLESS STEEL FASTENERS

A. All fasteners, screws or nails, associated with treated plywood or blocking, shall be stainless steel.

2.05 ROUGH HARDWARE

A. Furnish items of rough hardware as required to properly secure and assemble the work; i.e., nails, bolts, spikes screws, plates, power-driven fasteners, etc.

PART 3 - EXECUTION

3.01 WORKMANSHIP FOR FRAMING

A. Comply with minimum requirements as published in "Manual of Acceptable Practices to Minimum Property Standards", Publication 4930.1, U.S. Department of Housing and Urban Development (HUD).

B. Fit lumber closely and accurately set to required lines and levels. Splicing between bearing points will not be permitted. Full height, unspliced wood studs are required at all walls and partitions, unless noted otherwise.

C. Do all framing, cutting and patching of carpentry items required for the installation of work of all trades. Where it is necessary to cut framing, properly reinforce with headers the full depth of the framing.

D. Locate anchors and bolts to be built into masonry.

E. Shim furring strips and nailers to produce plane and true finished surfaces.

F. Carefully select all members. Select individual pieces so that knots and obvious defects will not interfere with placing bolts or properly nailing or making connections. Cut out and discard all defects which will render a piece unable to serve its intended function.

G. Set all horizontal or sloping members with crown "up".

H. Provide blocking within wall and ceiling framing as required to attach work specified in other Sections.

I. Do not notch, bore, or cut members for pipes, ducts, conduits or other reasons except as shown on the Drawings or as specifically approved in advance by the Architect.

J. Make all bearings full unless otherwise indicated on the Drawings. Finish all bearing surfaces on which structural members are to rest so as to give sure and even support. Where framing members slope, cut or notch the ends as required to give uniform bearing surface.

3.02 WORKMANSHIP FOR BLOCKING, NAILERS, FURRING STRIPS, ETC.

A. Provide wood blocking and nailers within stud walls and partitions as required to attach cabinets, adjustable shelf hardware, toilet compartments, toilet accessories, wood trim (provide continuous 2x wood blocking behind each run of standing and running trim), at door jambs, and other items specified in other Sections.

B. Wood blocking, nailers, furring strips, etc., shall be shimmed to produce a plumb and true finished surface.

END OF SECTION

SECTION 06 01 20 - FINISH CARPENTRY AND MILLWORK

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Provide and install the finish carpentry and architectural woodwork items indicated or required by the Drawings and as specified herein.
   1. Install wood doors under this Section. Refer to Sections 08210 and 08212.
   2. Millwork, including cabinets, paneling, and all standing and running trim, shall be installed by the millwork supplier.

B. Architectural Woodwork: All interior woodwork exposed to view in the finished Project, irrespective of finish, including wood, plywood, hard plastics, and hardboard.

C. Related work specified elsewhere:
   1. Furnishing of stile-and-rail doors: Section 08 14 33.
   2. Furnishing of finish hardware (other than as specified herein): Section 08 71 00.
   3. Section 08 81 00 – Glass and Glazing.
   4. "Opaque" finishes referred to hereinafter will be applied by the painting trade, Section 09 91 00.

D. Referenced standards in this specification shall not relieve the supplier of conforming with specific conditions and details indicated on the Drawings.

### 1.02 QUALITY STANDARDS

A. The "Quality Standards" of the Architectural Woodwork Institute shall apply and by reference is made a part of this Section. Any reference to "Premium", "Custom" or "Economy" grades on this Section shall be as defined in the latest edition of the AWI "Quality Standards". Referenced standards in this specification shall not relieve the supplier of conforming with specific conditions and details indicated on the Drawings. The more stringent of the referenced standards, or the Drawings, shall prevail.

B. Any item not given a quality grade designation shall be "Custom" grade as defined in AWI "Quality Standards".

C. Conform to requirements, where applicable, for specific materials:
   1. American Plywood Association (APA).
   2. Western Wood Products Association (WWPA).
   3. Other associations or agencies having jurisdiction over specific products.

D. Referenced standards in this specification shall not relieve the supplier of conforming with specific conditions and details indicated on the Drawings.

1.03 SUBMITTALS

A. Shop drawings showing each of the items to be provided under this Section shall be submitted for Architect's approval. Shop drawings shall completely detail joinery and other construction, including anchorage. Under no circumstances may the supplier use the architectural millwork drawings as base drawings for shop drawings; all shop drawings shall be generated by the supplier's experienced detailer. The millwork supplier shall detail the miscellaneous custom steel components. Provide keyed catalogue cutsheets for all specified cabinet hardware.

1.04 SAMPLES

A. Contractor shall submit samples of the following:
   1. Submit a 2' long sample of each running trim, including crown mould, chair rail, base, etc.

1.05 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Make no delivery of materials or products until the building is enclosed and the environment is conducive to protective storage.

B. Handle and store material in such a manner to prevent scarring of surfaces, chipping edges or corners, or otherwise damaging.

C. Store within enclosed building and maintain temperature and humidity requirements at levels determined by fabricator/installer. Do not install finish carpentry until required temperature and relative humidity conditions have been stabilized and will be maintained in installation areas.

D. Maintain temperature and humidity in installation areas as required to maintain moisture content of installed finish carpentry with a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. The fabricator of woodwork shall determine optimum moisture content and required temperature and humidity conditions.

E. Store materials off floor, on blocking or skids, in such a manner as to allow ventilation of surfaces.

F. Protect from damage during the storage period and during and after installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Millwork: Equal to products of either Southeastern Architectural Millwork, Inc., All Star Forest Products, Inc., or Scanlon-Taylor Millwork Company.

B. Cabinet hardware: Stanley Hardware Division, The Stanley Works, or equal; Hafele, or equal; Grass America; Timberline, or equal; Soss or equal; other manufacturers listed, or equal.

C. Miscellaneous hardware: Knape & Vogt Manufacturing Company, or equal.

2.02 MOISTURE CONTENT

A. All finish lumber and millwork shall have been dried to a maximum moisture content of 12%, with a minimum moisture content of 8%.

2.03 INTERIOR STANDING AND RUNNING TRIM MATERIALS

A. Miscellaneous Wood Trim (at Tenth and Eleventh Floors): AWI "Custom Grade" Poplar for an "opaque" (painted) finish (chair rail, base, crown mould).

B. Miscellaneous Wood Trim (at Ballroom 1200): Hardwood lumber for panel and desk trim to receive transparent finish. Where shown on Drawings, hardwood lumber to be AWI quarter-sawn Grade "1", Clear Mahogany, for "Premium" grade work.

C. Materials shall comply with requirements of AWI "Quality Standards", Section 300.

2.04 CABINET MATERIALS (For laminate clad cabinets)

A. Countertops, nosing and splashes shall be veneered on exposed surfaces with high-pressure plastic laminate equal to 1/16" thick "Nevamar". Color and pattern to be selected by Architect. The veneer shall be applied over exterior grade plywood substrate: 3/4" thick for countertops and splashes.

B. Cabinets
   1. Lumber shall be in accordance with the Architectural Woodwork Standards Grade specified for the product being fabricated.
   2. Core shall be medium-density fiberboard (MDF) meeting the requirements of Architectural Woodwork Standards.
   3. Plastic Laminate shall meet the requirements of the Architectural Woodwork Standards for its intended use.
   4. Cabinet Liner shall be type CLS.
   5. Adhesives used shall be type II.
   6. Edgeband shall be PVC.
   7. Drawer sides/slides shall be a composite, integrated drawer side/slide system, with interchangeable components, equal to the Zargen Drawer System, as manufactured by Grass America. System includes self-closing action and dual captive rollers, drawer front adjustment, and bumpers. Typical extension shall be ¾" extension.

C. Cabinet hardware shall be equal to products of Stanley and other manufacturers, as noted, and as follows:
   1. Hinges for flush overlay doors 1-pair #1511-9X center mount doors x US15 1-pair #1511-2 end mount doors x US15
   2. Door and drawer pulls 1-each #4483 1/2 x US32D
   3. Door/Drawer locks (where shown on Drawings): Timberline Lock, Ltd., 1-847-234-1864, #CB-280, Type 280 cylinder body with LP-100 plug.
   4. Drawer slides shall be as included in the composite system described at B.,3. above.
   5. Shelves shall be furnished with 4 each, #331 ANO Series Flat Top Shelf Support Pins, equal to product of Knape & Vogt.

2.05 FABRICATION (For "laminate clad" cabinets)

A. Plastic laminate clad cabinets shall be Architectural Woodwork Standards "Custom" Grade.

B. Exposed interior surfaces shall be per the requirements of the AWS for "Custom" Grade.

C. Semi-exposed surfaces shall be per the requirements of the AWS for "Custom" Grade.

D. Doors, drawer fronts, and false fronts shall be flush overlay.
a. Edgeband at doors, drawer fronts, and false fronts shall be 3mm PVC.

2.06 PANEL AND DESK (for millwork to receive "stained" finish at Ballroom 1200): All materials meet requirements of AWI "custom" grade.

A. Lumber shall be in accordance with the Architectural Woodwork Standards Grade specified for the product being fabricated.

B. Veneers shall be in accordance with the Architectural Woodwork Standards requirements for its use and the Grades.

C. Core shall be medium-density fiberboard (MDF) meeting the requirements of Architectural Woodwork Standards.

D. Edgeband: Veneer of the same species and cut as the exposed surfaces.

E. Adhesives used shall be Type 1.

2.07 FABRICATION (for "stained" finish millwork)

A. Millwork shall meet the requirements of the Architectural Woodwork Standards "Custom" Grade.

B. Exposed Surfaces shall be Mahogany, quarter sliced, book-matched, meeting the requirements of the AWS for the Grade specified.

C. Exposed interior surfaces shall be per the requirements of the Architectural Woodwork Standards.

D. Semi-exposed surfaces shall be per the requirements of the Architectural Woodwork Standards.

2.08 GROMMETS

A. Furnish "MG3" satin aluminum grommets, 2-1/16" clear inside diameter, as manufactured by Doug Mockett & Company, Inc., 1-800-523-1269, where shown on Drawings.

2.09 STAINLESS STEEL TUBE SUPPORTS

A. See Section 05 55 00.

2.10 STONE VANITY TOPS

A. See Section 09 30 00.

2.11 WOOD FINISHES

A. Manufacturer: Coronado Paint, Edgewater, FL, ph 800-883-4193 (local source: Seabrook Paint Co., ph 601-352-4074), or equal.

B. Materials;
   1. CSS Quick Seal Alkyd Stain, 3601 Series (custom mix if directed by Architect).
   2. CVS High Solids Catalyzed Sanding Sealer, 3515-11
   3. CVS High Solids Conversion Varnish, 3515 Series
   4. CVS High Solids Conversion Varnish, 3515 Series

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Work shall be cut, assembled, and finished at the mill wherever practical, and delivered ready for erection. All installation, and all stained finishing, shall be by the Section 06200 fabricator. Where it is necessary to cut portions on the job, materials shall be ordered with ample cutting allowance. Defects, bruises and stain shall be worked out in the cutting. All millwork shall be based on measurements taken at the job. Exposed surfaces shall be machine sanded unless otherwise noted. Mill assemblies shall be joined in accordance with standard practice as recommended by AWI. The best grade commercial glue shall be used. Nails and screws shall be concealed, or as detailed on Drawings. Intersecting moulding at corners shall be neatly mitered, or coped.

B. Finished work shall be plumb, erect, and true and shall be blind nailed or screwed. Blind nails shall be steel set and covered with banding. All woodwork shall be securely nailed to nailing blocks, grounds and furring.

C. Construct door frames for wood doors as necessary to provide a uniform clearance of 1/8" at jambs and head, and a uniform clearance at the threshold or floor to properly clear the floor covering. Install finish hardware using templates furnished with the hardware and appropriate tools and equipment for mortising, drilling, and planing the doors.

D. Anchor all cabinetwork and shelving securely, plumb, true, and level, without distortion. Accurately scribe and closely fit face plates, fillers and trim strips to adjacent surfaces. Wood blocking shall be provided within stud cavities as specified in Section 06100.

E. Coordinate and cut all openings in cabinetwork as required by other trades, such as piping, switch boxes, sinks, etc.

F. Unless otherwise indicated, all millwork shall comply with "Custom Grade" requirements of AWI "Quality Standards".

3.02 STANDING AND RUNNING TRIM

A. Wood trim shall be of sizes and profiles as indicated on the Drawings.

All replacement wood trim and wood components at existing building shall match the size and profile of existing work to remain. Wood trim shall be hollow back and shall have slightly "eased" edges. All trim, frame and casing members shall be of sufficient lengths to have no intermediate joints.

3.03 CABINETS

A. Install cabinets at gypsum board walls by securing to wood blocking within the stud space, provided under Section 06100. Cabinets shall be anchored to wood blocking with screws.

B. Install cabinets at concrete masonry unit walls by securing wood blocking to wall with expansion anchors.

C. Cabinet manufacture and installation shall comply with requirements of AWI "Quality Standards", Section 400.

3.04 NAILS, ANCHORS AND HARDWARE

A. All surface nails shall be steel set at mitered corners. Near the edge or end of a piece, pre-drill the nail hole to avoid splitting the wood.

END OF SECTION

SECTION 07 60 00 - FLASHING AND SHEET METAL (ALT #1)

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Furnish labor, materials, equipment, services and supervision as required to complete the flashing and sheet metal work indicated on the Drawings and specified herein.

### 1.02 QUALITY STANDARDS

A. Materials, detailing, fabrication, workmanship and installation shall comply with recommendations of the manufacturer and as recommended by the latest editions of:
   1. Architectural Sheet Metal Manual, a publication of Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
   2. Copper and Common Sense, a publication of Revere Copper Products, Inc.
   3. "Copper in Architecture Handbook", as published by the Copper Development Association.
   4. Modern Application of Sheet Copper in Building Construction, 1948 Ed.

### 1.03 QUALITY ASSURANCE

A. The shop fabricating all sheet metal for this job shall be ANSI/SPRI ES-1 certified to shop/field form any metal edge system, and the individuals installing the sheet metal shall bear ES-1 certification, and shall submit evidence of such certification. The certified installers shall be approved by the Architect/Owner. Applicators of roofing systems (built-up, modified bituminous, shingle, or metal roofing) shall NOT install sheetmetal work of this Section, or of work specified at Section 07635. ALL sheet metal work shall be installed by skilled ES-1 certified mechanics, and shall be installed undistorted or bent or dented, properly anchored and cleated, with proper solders per industry standard, etc.

B. The roofing contractor specializing in sheet metal flashing work shall have a minimum of five (5) years experience.

C. Contractor must also maintain a full-time sheet metal supervisor/foreman who is on the job-site at all times during installation of sheet metal. Foreman must have a minimum of five (5) years experience with the installation of similar system to that specified, and shall be ES-1 certified.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

A. Sheet metal shall be cold-rolled, mill-finish copper, equal to product of Revere Copper Products, Inc.
   1. Copper shall weigh 20 ounces per square foot and shall comply with ASTM Specification B370.
   2. Fasteners for attachment to wood shall be copper or hardware bronze nails, of sufficient length to penetrate into wood not less than 1".
   3. Rivets shall be of hard copper, brass or bronze.

4. Screws and bolts shall be copper, brass, bronze, or stainless steel (passive).
5. Solder shall be 50% block tin and 50% pig lead, conforming to ASTM Specification B32.
6. Flux shall be an approved brand of soldering flux. Acid shall be thoroughly washed off after soldering is completed.

B. Sheetmetal for capflashing at areaway shall be .050" prefinished Kynar aluminum.

C. Nails used for fastening copper shall be copper or hardware bronze of "Stronghold" type, with large flat head. They shall not be smaller than No. 12 Stubs gauge (0.109") and of sufficient length to penetrate roof sheathing or wood framing not less than 1".

D. Cleats shall be 2" wide by approximately 3" long and shall be made of 20 ounce cold-rolled copper (or matching material to that being secured), unless otherwise specified. One end shall be locked into seams or into folded edge of copper sheets. Other end shall be nailed with two nails and folded back over nailheads. When expansion cleats are used, they shall be the same overall dimensions as fixed cleats.

E. Anchorage: all metals shall be attached to masonry or concrete with stainless steel drive pins. At anchorage to wood, copper shall be attached with fasteners previously specified.

F. High temp (HT) membrane: Grace "Ultra".

## PART 3 - EXECUTION

### 3.01 SURFACES TO RECEIVE SHEET METAL

A. Surfaces to be covered with sheet metal shall be smooth and free from defects of every description. All such surfaces shall be cleaned of dirt, rubbish, and other foreign materials before sheet metal work is started. All projecting nails shall be driven flush with roof sheathing and wood framing.

### 3.02 WORKMANSHIP AND INSTALLATION

A. Material shall be fabricated and installed as recommended by the manufacturer and as recommended by the latest editions of:
1. "Architectural Sheet Metal Manual" of Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
2. "Copper and Common Sense", a publication of Revere Copper Products, Inc.
3. "Copper in Architecture Handbook", as published by the Copper Development Association.
4. Modern Application of Sheet Copper in Building Construction, 1948 Ed.

B. Form all sheet metal accurately and to the dimensions and shapes required. Finish all moulded and broken surfaces with true, sharp and straight lines and angles and, where intercepting other members, cope to an accurate fit. Copper sheet metal shall be soldered watertight; except at lapped joints in cap flashing and at 1/4" spaced joints of copings and metal edges.

C. Unless otherwise specifically permitted by the Architect, fold (hem) all exposed edges back 1/2” minimum; 3/4” hem where a concealed cleat is to be provided.

D. Provide for thermal expansion of exposed sheet metal work exceeding 15 foot running length.
   1. Metal edges, copings, cap flashing and trim: Provide movement joints at maximum spacing of 10 feet; no movement joints allowed within 2 feet of corners or intersections. Corners (both inside and outside) and inter-sections shall be installed as follows: lap joints a minimum of 3”, rivet 1-1/2” on center, and solder watertight.
   (Exception: At sheet metal roofing refer to Paragraph 3.06 for spacing of expansion joints.)

3.03 GENERAL

A. Secure fascia to wood nailers at bottom edge with a continuous cleat.

B. Fastening of metal to walls and wood blocking shall comply with building code standards, or as shown on Drawings, whichever is the more stringent.

C. All accessories or other items essential to the completeness of sheet metal installation, whether specifically indicated or not, shall be provided and of the same material as item to which applied.

D. Allow sufficient clearances for expansion and contraction of linear metal components. Secure metal using fasteners as required by the system. Exposed face fastening will be rejected.

3.04 INSPECTION

A. Verify that curbs are solidly set and nailing strips located.

B. Perform field measurements prior to fabrication.

C. Coordinate work with work of other trades.

D. Verify that substrate is dry, clean and free of foreign matter.

E. Commencement of installation shall be considered acceptance of existing conditions.

3.05 SHOP-FABRICATED SHEET METAL

A. Metal work shall be shop fabricated to configurations and forms in accordance with Drawings and with recognized sheet metal practices.

B. Hem exposed edges.

C. Where shown on Drawings, angle bottom edges of exposed vertical surfaces to form drip.

D. Lap corners with adjoining pieces fastened and set in sealant (or, solder and rivet copper).

E. Form joints for gravel stop fascia system, coping cap with a 3/8”-1/2”

opening between sections. Back the opening with an internal drainage plate formed to the profile of fascia piece.

F. Maximum length of metal sections shall be 10’-0”.
G. Install sheet metal to comply with referenced ANSI/SPRI, SMACNA and NRCA standards.

3.06 DISSIMILAR METAL SEPARATION

A. Dissimilar metals shall be separated from one another in order to prevent damage from electrolysis, by use of a separator film or strip from one of the following materials:
   1. Heavy waterproof paper or felt
   2. A heavy coat of bituminous paint
   3. Elastomeric film.

3.07 SHEET METAL ANCHORAGE

A. Unless specifically noted otherwise in Specifications, the following anchorage spacings shall be utilized:
   1. All continuous cleats: nail or fasten at 6” o.c.
   2. All 2”-wide cleats at copper work: (2) fasteners per cleat.
   3. All horizontal nailing flanges (e.g., gravelguards, eave strips, rake trim, etc.): fasten at 3” o.c.
   4. All cap flashing anchored to masonry or concrete substrates (e.g., parapets): fasten with stainless steel drivepins at 6” o.c.

B. All anchors that fasten into treated lumber blocking shall be Type 304 or Type 316 stainless steel.

3.08 TINNING

A. Edges of all uncoated copper, lead-coated copper, and tin-zinc alloy coated copper to be soldered shall be tinned with solder, and fluxed, on both sides for width not less than 1-1/2”, before lock seams are engaged.

3.09 SOLDERING OF COPPER SHEET METAL

A. Clean both surfaces to be soldered, removing oils and foreign matter.

B. Pre-tin edges of all uncoated copper to be soldered with solder on both sides for width not less than 1-1/2” (lead-coated copper need not be pre-tinned). Wipe pre-tin with rag to keep tinning light. Re-flux. At linear flashing conditions, rivet joint with rivets at 1½” o.c., staggered, per Copper Development Association detail; riveting shall not be required at flat seam panels.

C. All soldering shall be done slowly with well heated coppers, or map gas heated irons similar to Aero "Duplex Soldering Torch" with #12 Copper Iron – to heat sheet metal thoroughly and to sweat solder completely through full width of seam. Ample solder shall be used and seam shall show at least 1½” of evenly flowed solder. Wherever possible, all soldering shall be done in flat position. Seams on slopes steeper than 45 degrees shall be soldered a second time. Solder over all rivets.

D. Soldering shall be done with heavy soldering coppers of blunt design,

properly tinned before using. For flat seam work and gutters, they shall weigh not less than 10 lbs. per pair. Do not use torches.

E. To ensure that solder is drawing completely through the lock, soldering copper shall be placed on top of the seam, and copper shall be at least as wide as the seam, preferably wider.

F. Seams and locks shall be full of solder, and completely covered with solder over their tops.

G. All locks and seams must be completely soldered within (4) hours of being installed, or exposed to the elements.

H. Completely remove flux and spatter from exposed surfaces.

3.10 METAL CAP FLASHING REPAIRS

A. Coping repair pieces shall match existing.

B. Both faces of copings shall be secured to continuous hold-down cleats. Hold-down cleats shall be screwed to continuous wood nailer.

C. Provide 1/4” wide gap between capflashing sections. Rivet and solid-solder 6”-wide copper patch over this seam.

END OF SECTION

SECTION 07 90 00 – JOINT PROTECTION (Alternate #1)

## PART 1 - GENERAL

### 1.01 SUMMARY

A. Section Includes: Surface preparation and installation of elastomeric sealant in joints including terra cotta to terra cotta, stone to stone, wood to wood, wood to masonry, metal to metal, and metal to masonry.

B. Related Sections:
   1. Section 04 21 29 - Terra Cotta Restoration
   2. Section 04 43 00 – Stone Masonry
   3. Section 07 60 00 - Flashing and Sheet Metal
   4. Section 09 91 00 - Painting

### 1.02 QUALITY ASSURANCE

A. Qualifications:
   1. Contractor must have a minimum of five (5) years experience in installation of caulking and sealants.

### 1.03 SUBMITTALS

A. Manufacturer's Literature: Materials description and installation instructions for each compound and filler.

B. Samples: Samples of each compound, filler, and backing. Submit actual sealant bead samples for color selection by the Owner's Representative and Architect/Engineer.

C. Material Safety Data Sheets (MSDS): All sealant materials and primer.

D. Certification of Application: Submit letter from each sealant manufacturer stating that they have reviewed the drawings and that their product is appropriate for the intended use as well as providing their recommendations for cleaning and priming of bond surfaces.

### 1.04 JOB CONDITIONS

A. Environmental Conditions: Do not apply sealant if precipitation appears imminent.

B. Temperature: Do not apply sealant when the air temperature is below 40° F.

C. Protection: Precautions should be taken to avoid damage to any surface near the work zone due to the mixing and handling of the sealant.

D. Hazardous Materials: Lead paint is present on the windows and asbestos or other hazardous materials are present in perimeter sealants and glazing compounds. Specifically, asbestos containing materials have been identified in sealants around window frames and in reinforced mastic. Asbestos containing materials have not been identified in glazing putty. Refer to Appendix A: Owner-Furnished Asbestos-Containing Materials and Lead-Based Paint Survey. Contractor shall coordinate abatement with Section 02000 - Asbestos Abatement and shall undertake all required precautions and protection for Contractor personnel and safe disposal of debris.

1.05 PRODUCT DELIVERY, HANDLING AND STORAGE

A. All materials shall be delivered to the job site in manufacturer's sealed packaging and stored in an enclosed shelter providing protection from damage and exposure to the elements. Damaged or deteriorated materials shall be removed from the premises.

B. Store and condition the specified products as recommended by the product manufacturer. Storage location shall be so designated by the Owner's Representative.

## PART 2 - PRODUCTS

2.01 SEALANT MATERIALS

A. Sealant for joints between masonry and wood or metal substrates: One part silicone, Dow 76 or approved equal. Custom colors to match adjacent finishes to be selected by Architect.

B. Backer Rod: Closed cell backer rod, as recommended by the sealant manufacturer for the specific joint surface and conditions.

C. Bond Breaker Tape: Type recommended by the sealant manufacturer for the specific joint surface and conditions.

D. Joint Primer and Cleaner: Type recommended by the sealant manufacturer for the specific joint surface and conditions. If Primer is not used, Contractor must submit to the Owner a letter from the sealant manufacturer stating that it is not required for specific application(s).

## PART 3 - EXECUTION

3.01 PREPARATION

A. Select only sealing compounds of manufacturers who agree to have a qualified representative visit the site at the beginning of the joint sealing work and periodically thereafter as necessary to ensure the proper installation of the sealing compounds.

B. Examine all surfaces to receive the parts of the Work specified herein. All surfaces must be clean, dry, sound and free of frost.

At all times, follow the manufacturer's recommendations. Application or installation of material constitutes acceptance of the substrate.

C. Clean surfaces and remove all sealant and protective coatings, which might fail in adhesion or interfere with bond of compound, so that surfaces are free of deleterious substances which might impair the Work. Except as otherwise approved by the manufacturer, elastomeric sealants shall not be applied to joint surfaces previously treated with paint, lacquer, sealer, curing compound, water repellent or other coatings unless such coatings have been entirely removed.

D. Allow painted surfaces to fully cure as recommended by paint manufacturer before installing sealant.

3.02 INSTALLATION, GENERAL

A. Install all materials in accordance with the manufacturer’s printed instructions. Unless otherwise directed, conform with the following:
   1. Compounds shall not be installed below a temperature of 40° F unless approved in writing by Architect.
   2. Confine compounds to joint areas shown. Use masking tape to prevent staining of adjoining surfaces or spillage and migration of compound out of the joints. Tool surface to shape shown or, if none is shown, to flush or slightly concave surface.
   3. Use power driven equipment wherever possible to install compounds so as to ensure uniformity of application and the highest quality of workmanship.
   4. Daily records will be maintained by Contractor where exterior sealant applications have been made.

3.03 INSTALLATION OF SEALANT

A. Complete adjacent repairs and allow paint and coatings to fully cure before proceeding with sealant installation.

B. Remove existing sealant from joints designated on the Drawings to receive sealant. Substrates shall be free of sealant residues.

C. Prime surfaces in accordance with the instructions of the sealant manufacturer. If manufacturer does not recommend primer, Contractor must submit a letter from the manufacturer stating that it is not required on this building before any sealant is installed.

D. Install bond breakers in locations and of type recommended by the sealant manufacturer to prevent bond of sealant to surfaces where such bond might impair the performance of the sealant.

E. Install backer rod of appropriate size and to appropriate depth as needed to create sealant profiles shown on the Drawings for the existing joint or crack width.

F. Install sealant and tool to a concave profile.

G. At all “skyward-facing” head joints to receive sealant that must “marry” to mortared head joints below, broadcast by hand light

coating of sand into the wet, tooled sealant. Sand shall match that used in repointing mortars.

H. Cure sealant fully in accordance with manufacturer's recommendations.

3.04 FIELD QUALIFICATION TEST

A. Perform trial sealant applications for all substrates in trial areas selected by the Architect prior to complete mobilization for review to determine the adhesive strength of the sealant and any necessary revisions to sealant application procedures. Sealant supplier is to be present. Only based upon successful test results can further activity proceed. The initial sealant application in the trial test area shall be made in accordance with written instructions from the sealant manufacturer indicating cleaning, priming and application procedures. After an appropriate cure period, a field adhesion test is to be performed as indicated below. Include in this trial application a sample of sand broadcast specified at 3.03/G. above.

B. As a check for adhesion, a hand pull test shall be conducted in the trial test area after the sealant is fully cured (usually within 14 to 21 days). The test shall be performed in accordance with the following procedure. The procedure describes a test on a vertical joint.
   1. Make a knife cut horizontally from one side of the joint to the other.
   2. Make two vertical cuts approximately 2 inch long at the sides of the joint meeting the horizontal cut at the top of the 2 inch cuts.
   3. Grasp the 2 inch piece of sealant firmly between fingers and pull down at a 90 degree angle or more and try to pull the uncut sealant out of the joint.
   4. If adhesion is proper, the sealant should tear cohesively (within itself) before releasing from the substrate.
   5. Areas experiencing failures will be examined and these areas will have the existing sealant removed and then the surfaces re-cleaned, primed and the sealant reapplied.

C. Sealant must be replaced in test area by cleaning, priming and then applying more sealant in the same manner as was originally installed (assuming good adhesion was obtained). Care should be taken to assure that the new sealant is in contact with the original and that the original sealant surfaces are clean and primed so that good bond between the new and old sealant will be obtained. Check with sealant manufacturers for proper techniques for repair areas.

D. Test areas will be selected by the Architect. Areas experiencing failure will have all material removed and resealed as necessary to assure good adhesive bond of the sealant.

3.05 CLEAN UP

A. As Work progresses, remove excess compound and clean adjoining surfaces as may be required to eliminate any indication or soiling or migration.

B. At the conclusion of sealing and caulking work, remove all scaffolding and equipment used in the Work, clean up all debris and surplus material and remove same from the premises.

END OF SECTION

SECTION 07 92 00 - SEALANTS AND CAULKING

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Seal and caulk all joints where shown on Drawings, as specified herein, and elsewhere as required to close open joints and to provide a positive barrier against the passage of air or moisture, and to provide fire rated construction where required.

B. Work to be sealed or caulked:

1. Interior
   a. Perimeter of new door openings.
   b. Perimeter of wood window trim.
   d. Joints between dissimilar materials.
   e. Miscellaneous open joints.
   f. Fire-rated construction joints and penetrations.
   g. Control joints at tile flooring.
   h. Plumbing fixtures.

C. Related work specified elsewhere:
1. Section 09 30 00 - Ceramic Tile and Cut Natural Stone Elements.
2. Section 09 91 00 - Painting.

### 1.01 QUALITY ASSURANCE

A. Qualifications:
1. Contractor must have a minimum of five (5) years experience in installation of caulking and sealants.

### 1.02 SUBMITTALS

A. Manufacturer’s Literature: Materials description and installation instructions for each compound and filler.

B. Samples: Samples of each compound, filler, and backing. Submit actual sealant bead samples for color selection by the Owner’s Representative and Architect/Engineer.

C. Material Safety Data Sheets (MSDS): All sealant materials and primer.

D. Certification of Application: Submit letter from each sealant manufacturer stating that they have reviewed the drawings and that their product is appropriate for the intended use as well as providing their recommendations for cleaning and priming of bond surfaces.

### 1.03 JOB CONDITIONS

A. Environmental Conditions: Do not apply sealant if precipitation appears imminent.

B. Temperature: Do not apply sealant when the air temperature is below 40° F.

C. Protection: Precautions should be taken to avoid damage to any surface near the work zone due to the mixing and handling of the sealant.

1.04 PRODUCT DELIVERY, HANDLING AND STORAGE

A. All materials shall be delivered to the job site in manufacturer's sealed packaging and stored in an enclosed shelter providing protection from damage and exposure to the elements. Damaged or deteriorated materials shall be removed from the premises.

B. Store and condition the specified products as recommended by the product manufacturer. Storage location shall be so designated by the Owner's Representative.

## PART 2 - PRODUCTS

2.01 SEALANT MATERIALS

A. Interior building sealant/dry locations:
   1. "Sonolac Acrylic Latex Caulk", by Sonneborn.
   2. Self-priming acrylic latex base caulk.
   3. Single component, gun grade.
   4. ASTM C834; USDA approved.
   5. Colors as selected by Architect.

C. Interior building sealant/wet locations:(plumbing fixtures, etc.)
   1. "Sonolastic OmniPlus," silicone sealant, by Sonneborn.
   2. Single component, nonsag, gun grade.
   3. Federal Specification TT-S-00230C, Type II, Class A.
   4. Colors as selected by Architect.

D. Interior building sealant at porcelain and ceramic tile control and perimeter joint locations, and stone countertop joints:
   1. "Latisil Tile and Stone Sealant", by Laticrete.
   2. High performance silicone sealant.
   3. Single component, gun grade.
   4. ASTM C920; ASTM C794.
   5. Color: match grout color.

E. Firestopping:
   1. Construction-gap firestopping occurring at the top of fire-rated walls (1-hr., 2-hr., and 3-hr.):"3M Fire Barrier 2000", U.L. System No. HWD0013.
   2. Through-penetration firestopping in fire-rated construction (1-hr., 2-hr., and 3-hr.): "3M Fire Barrier 3000", U.L. System No. CAJ1001.

F. Backer rod:
   1. "Sonofoam Backer-Rod."
   2. Resilient closed-cell polyethylene foam extrusion.

G. Bond Breaker Tape: Type recommended by the sealant manufacturer for the specific joint surface and conditions.

H. Joint Primer and Cleaner: Type recommended by the sealant manufacturer for the specific joint surface and conditions. If Primer is not used, Contractor must submit to the Owner a letter from the sealant manufacturer stating that it is not required for specific application(s).

## PART 3 - EXECUTION

### 3.01 PREPARATION

A. Select only sealing compounds of manufacturers who agree to have a qualified representative visit the site at the beginning of the joint sealing work and periodically thereafter as necessary to ensure the proper installation of the sealing compounds and satisfy warranty requirements.

B. Examine all surfaces to receive the parts of the Work specified herein. All surfaces must be clean, dry, sound and free of frost. At all times, follow the manufacturer's recommendations. Application or installation of material constitutes acceptance of the substrate.

C. Clean surfaces and remove all sealant and protective coatings, which might fail in adhesion or interfere with bond of compound, so that surfaces are free of deleterious substances which might impair the Work. Except as otherwise approved by the manufacturer, elastomeric sealants shall not be applied to joint surfaces previously treated with paint, lacquer, sealer, curing compound, water repellent or other coatings unless such coatings have been entirely removed.

D. Allow painted surfaces to fully cure as recommended by paint manufacturer before installing sealant.

### 3.02 INSTALLATION, GENERAL

A. Install all materials in accordance with the manufacturer’s printed instructions. Unless otherwise directed, conform with the following:
   1. Compounds shall not be installed below a temperature of 40° F unless approved in writing by Architect.
   2. Confine compounds to joint areas shown. Use masking tape to prevent staining of adjoining surfaces or spillage and migration of compound out of the joints. Tool surface to shape shown or, if none is shown, to flush or slightly concave surface.
   3. Use power driven equipment wherever possible to install compounds so as to ensure uniformity of application and the highest quality of workmanship.
   4. Daily records will be maintained by Contractor where exterior sealant applications have been made.

### 3.03 INSTALLATION OF SEALANTS (EXCEPT FOR FIRESTOPPING SEALANT)

A. Complete adjacent repairs and allow paint and coatings to fully cure before proceeding with sealant installation.

B. Remove existing sealant from joints designated on the Drawings to receive sealant. Substrates shall be free of sealant residues.

C. Prime surfaces in accordance with the instructions of the sealant manufacturer. If manufacturer does not recommend primer, Contractor must submit a letter from the manufacturer stating that it is not required on this building before any sealant is installed.

D. Install bond breakers in locations and of type recommended by the sealant manufacturer to prevent bond of sealant to surfaces where such bond might impair the performance of the sealant.

E. Install backer rod of appropriate size and to appropriate depth as needed to create sealant profiles shown on the Drawings for the existing joint or crack width.

F. Install sealant and tool to a concave profile.

G. Cure sealant fully in accordance with manufacturer's recommendations.

3.04 INSTALLATION OF FIRESTOPPING SEALANT

A. Install penetration seal materials with fire rating equal to or exceeding the greater fire rating of the planes to be sealed, in accordance with printed instructions of the U.L. Fire Resistance Directory and in accordance with manufacturer's instruction.

B. Seal all holes or voids made by penetrations through walls or floors to ensure an effective smoke barrier.

C. Where floor openings without penetrating items are more than four inches in width and subject to traffic or loading, install firestopping materials capable of supporting same loading as floor.

D. Protect materials from damage on surfaces subject to traffic.

E. Where large openings are created in walls or floors to permit installation of pipes, ducts, cable tray, bus duct or other items, close unused portions of opening with firestopping materials tested for the application. See U.L. Fire Resistance Directory or Warnock Hersey approvals.

F. Install firestopping at all locations where smokestopping is required, as specified in 3.04/A.

3.05 FIELD QUALIFICATION TEST FOR SEALANTS (EXCEPT FOR FIRESTOPPING SEALANT)

A. Perform 4'-long trial sealant applications for all substrates in trial areas selected by the Architect prior to complete mobilization for review (by sealant manufacturer's designated technical representative, not sales representative) to determine the adhesive strength of the sealant and any necessary revisions to sealant application procedures. Sealant supplier is to be present. Only based upon successful test results can further activity proceed. The initial sealant application in the trial test area shall be made in accordance with written instructions from the sealant manufacturer indicating cleaning, priming and application procedures. After an appropriate cure period, a field adhesion test is to be performed as indicated below. Include in this trial application a sample of sand broadcast specified at 3.03/G. above.

B. As a check for adhesion, a hand pull test shall be conducted in the trial test area after the sealant is fully cured (usually within 7 to 21 days). The test shall be performed in accordance with the following procedure. The procedure describes a test on a vertical joint.
   1. Make a knife cut horizontally from one side of the joint to the other.
   2. Make two vertical cuts approximately 2 inch long at the sides of the joint meeting the horizontal cut at the top of the 2 inch cuts.

3. Grasp the 2 inch piece of sealant firmly between fingers and pull down at a 90 degree angle or more and try to pull the uncut sealant out of the joint.
4. If adhesion is proper, the sealant should tear cohesively (within itself) before releasing from the substrate.
5. Areas experiencing failures will be examined and these areas will have the existing sealant removed and then the surfaces re-cleaned, primed and the sealant reapplied.

C. Sealant must be replaced in test area by cleaning, priming and then applying more sealant in the same manner as was originally installed (assuming good adhesion was obtained). Care should be taken to assure that the new sealant is in contact with the original and that the original sealant surfaces are clean and primed so that good bond between the new and old sealant will be obtained. Check with sealant manufacturers for proper techniques for repair areas.

D. Test areas will be selected by the Architect. Areas experiencing failure will have all material removed and resealed as necessary to assure good adhesive bond of the sealant.

3.06 FIELD QUALITY CONTROL FOR FIRESTOPPING SEALANT

A. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable code authorities.

C. Perform under this Section patching and repairing of firestopping caused by cutting or penetration by other trades.

3.07 CLEAN UP

A. As Work progresses, remove excess compound and clean adjoining surfaces as may be required to eliminate any indication or soiling or migration.
B. At the conclusion of sealing and caulking work, remove all scaffolding and equipment used in the Work, clean up all debris and surplus material and remove same from the premises.

END OF SECTION

SECTION 08 11 13 - HOLLOW METAL FRAMES

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Furnish and install the hollow metal frames as indicated on the Drawings and as specified herein.

### 1.02 COORDINATION

A. The supplier of hollow metal frames will be furnished with an approved finish hardware schedule and hardware preparation templates as required to properly coordinate his work with that of other trades.

### 1.03 SHOP DRAWINGS

A. Submit shop drawings of hollow metal frames and doors to the Architect for approval prior to the fabrication of any work. Shop drawings shall indicate the door model numbers.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURER

A. Frames and doors shall be equal to the products of Curries. Sizes and details are as indicated on the Drawings.

### 2.02 HOLLOW METAL FRAMES AND SASHES (WELDED)

A. Frames shall be F-Series with 1" and 2" wide flush jamb face, and 2” head (or as detailed on Drawings), 20-minute UL-rated as indicated on the drawings. Frames shall be set-up and welded full length of joints, with exposed welds ground flush and smooth. Corners shall be mitered. Exposed fasteners will not be permitted.
   1. Interior frames shall be manufactured from 16-gauge cold rolled steel conforming to ASTM Specification A366.

B. Frames shall have 7-gauge steel hinge reinforcing. In addition, top hinge shall be provided with 1 pair of Part No. 30 auxiliary hinge reinforcements, each arc-welded in three places.

C. Metal plaster guards shall be provided for all mortised cutouts. Provide 12-gauge reinforcement for surface mounted closers.

D. Frames shall be furnished with wall anchors and base anchors of manufacturer's standard design, and as detailed, except that wire anchors will not be acceptable at masonry walls. 18 gauge steel "T" strap anchors shall be provided at masonry walls, (3) minimum per jamb up to 8’-0” in height, (4) minimum up to 12’-0” in height.

E. Frames at all restrooms and janitor closets shall be hot-dipped galvanized.

F. Frames shall be coated with manufacturer's standard rust retardant metal primer, after fabrication.

G. Provide steel channel spreader bar tack-weld at bottom of each door frame. Spreader bar shall be left in place until after frame is in place and securely anchored.

H. Prepare frames for three (3) resilient silencers per strike jamb and two (2) per head.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. Installation shall be by skilled mechanics experienced in such work.

B. Frames shall be installed plumb, level, true to plane and shall be secured in place as required to resist all forces acting upon them as indicated on manufacturer's shop and erection drawings.

C. A minimum of three (3) anchors shall be provided at each jamb. Anchors shall be installed immediately above or below each hinge reinforcement on the hinge jamb and directly opposite the strike on the strike jamb.

D. All fasteners shall be concealed, except at steel channel glazing stops, and of non-corrosive metals.

E. Touch-up bare or abraded places on metal frames and doors with suitable metal paint primer.

END OF SECTION

SECTION 08 14 00 - WOOD DOORS

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Furnish factory stained and finished wood doors as indicated on the Drawings and as specified herein. Doors will be installed as specified in Section 06 01 20 - Finish Carpentry and Millwork.

B. Related Work specified elsewhere:
   1. Section 06 01 20 - Finish Carpentry and Millwork
   2. Section 08 14 33 - Stile and Rail Wood Doors
   3. Section 08 71 00 - Finish Hardware
   4. Section 08 81 00 - Glass and Glazing

### 1.02 QUALITY STANDARDS

A. Flush wood doors shall comply with applicable requirements of "Architectural Woodwork Quality Standards", Section 1300, of Architectural Woodwork Institute (AWI). Doors shall meet or exceed WDMA "Extra Heavy Duty" Standards and WDMA "Premium" aesthetic, and AWI requirements for:
   1. Type PC-5 (non-labeled doors).
   2. 20 minute labeled doors.

### 1.03 SUBMITTALS

A. Shop Drawings: Submit shop drawings and product data to Architect for approval, prior to ordering doors.

B. Door Samples: Submit one or more samples (8"x10" minimum) of flush door construction cut from top corner, illustrating expected range of face veneer grain and color.

C. Standard Factory Finish Samples: Submit ¼" plywood (with veneer of species specified) samples (8"x10" minimum) of all of manufacturer's standard stain colors (12 minimum) and submit to Architect for selection. Color cards are not acceptable.

### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Package doors in accordance with AWI Quality Standards, Section 1300. Protect doors with resilient packaging (sealed with heat shrunk plastic wrap). Break seals on-site to permit ventilation.

B. Deliver, store, protect and handle doors to and on-site in accordance with requirements of the manufacturer, AWI Quality Standards, and provisions of Section 01 60 00.

C. Do not deliver wood doors to the Project until time for installation or until provisions for proper conditioning of doors are in effect.

### 1.05 WARRANTY FOR FLUSH DOORS

A. Doors shall be furnished with manufacturer's written warranty for life of original installation.

1. Any defects discovered during warranty period shall be corrected at no cost to Owner. Such corrective work shall include labor and material removing, repairing, and/or replacement, refinishing, and rehanging as required.
2. Include coverage for delamination of veneer, warping beyond specified AWI installation tolerances, defective materials and telegraphing core construction.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Flush wood doors shall be equal to products of Graham Door Co., or equal.

### 2.02 FLUSH DOORS (NON-LABELED)

A. Doors shall be 5-ply flush veneer, particleboard core type. Doors shall be 1-3/4” thick.

B. Typical doors shall be faced with plain sliced, premium grade, select Mahogany veneer with A-Grade faces, for factory finishing.

C. Edge species solid lumber shall match that of face veneers.

D. Where indicated, provide factory-cut openings with select Mahogany stops as detailed on Drawings. Opening sizes are indicated on Drawings.

### 2.03 FLUSH DOORS (20-MINUTE)

A. Doors shall be 5-ply flush veneer GPD-AF-45 non-asbestos agrifiber core type. Doors shall be 1-3/4" thick.

B. Doors shall be faced with plain sliced, premium grade, select Mahogany veneer with A-Grade faces, for factory finishing.

C. Edge species solid lumber shall match that of face veneers and shall be fire-retardant treated.

D. Doors shall have special reinforced inner blocking to provide extra strength for securing hardware. Top and bottom blocking shall be 5-1/2” tall and intermediate blocking shall be 10” tall.

E. Doors noted on schedule shall be classified and labeled by UL-Inc., as 20-minute doors.

### 2.05 FABRICATION

A. Doors shall be factory trimmed for hanging and machined for hardware installation.

### 2.06 DOOR FINISH

A. Factory finish doors in accordance with AWI Quality Standards, Section 1500. Factory finish shall be water-based stain and ultraviolet (UV) cured polyurethane sealer to comply with EPA Title 5 guidelines for Volatile Organic Compound (VOC) emissions limitations. Finish shall meet

or exceed performance standards of WDMA TR-6 catalyzed polyurethane.

B. Factory finish shall be CUSTOM stain color, to match existing in building, with a satin gloss finish as selected by Architect.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. Wood doors shall be installed as recommended by the manufacturer and as specified in Section 06 01 20 - Finish Carpentry and Millwork.

B. Install fire rated doors in strict accordance with NFPA 80 requirements.

C. Installation shall be by skilled mechanics experienced in such work and using appropriate electrically-operated tools and equipment.

D. Provide drilled pilot holes for all screws and bolts.

E. Finish any cut edges of doors to match factory finish, using procedures and materials furnished by door manufacturer.

END OF SECTION

SECTION 08 14 33 - STILE AND RAIL WOOD DOORS

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.02 SUMMARY

A. Section Includes:
   1. Interior fire-rated stile and rail wood doors and wood frames.
   2. Factory finishing stile and rail wood doors.
   3. Light frames and glazing installed in stile and rail wood doors.

B. Related Sections:
   1. Section 06 01 20 - Finish Carpentry and Millwork
   2. Section 08 14 00 - Wood Doors
   3. Section 08 81 00 - Glass Glazing
   4. Section 08 71 00 - Finish Hardware

C. Standards and References: Comply with the version year adopted by the authority having jurisdiction.
   1. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
   2. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
   3. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
   4. Scientific Certification Systems (SCS) - Certified Products Standards.
   5. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
   6. United States Green Building Council (USGBC).
   7. Window and Door Manufacturers Association - WDMA I.S.6-A Industry Standard for Architectural Stile and Rail Doors.

### 1.03 SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.6-A classifications. include factory finishing specifications as applicable.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the wood door supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop drawings: indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
   1. Indicate dimensions and locations of mortises and holes for hardware.
   2. Indicate dimensions and locations of cutouts.
   3. Indicate requirements for veneer matching.
   4. Indicate doors to be factory finished and finish requirements.
   5. Indicate fire protection ratings for fire rated doors.

D. Samples for Initial Selection: For each species and finish required.
   1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
   2. Corner sections of doors, 8 by 10 inches, with door faces and edges representing actual materials to be used.
      a. Provide samples for each species of veneer and solid lumber required.
      b. Finish veneer faced door samples with same materials proposed for factory finished doors.
   3. Frames for light openings, 6 inches long, for each material, type, and finish required.

E. Warranty: Sample of special warranties.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain stile and rail wood doors through one source from a single manufacturer wherever possible.

B. Quality Standard for Doors of Stock and Special Design and Construction: Comply with SDMA I.S.6-A, Industry Standard for Architectural Stile and Rail Doors.

C. Fire Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire rating indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL 10C (neutral pressure testing according to UL 10B where specified).
   1. Temperature Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 degrees F above ambient after 30 minutes of standard fire test exposure.
   2. Smoke Control Door Assemblies: Comply with NFPA 105.
      a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Mark each door on top rail with opening number used on Shop Drawings.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   1. Temperature and Relative Humidity Requirements: Relative humidity to

be 25 to 55 percent; temperature 60 to 80 degrees F. Maintain required temperature and relative humidity in spaces where products will be installed for a minimum of 24 hours before, during, and after installation as recommended by manufacturer.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form signed by manufacturer, installer, and contractor in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
   2. Warranty Period for Interior Stile and Rail Doors: One (1) year according to manufacturer's written warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 STILE AND RAIL DOOR CONSTRUCTION - GENERAL

A. WDMA I.S.6-A Grade for Transparent Finish: Premium. Assemble doors, including components, with minimum WDMA Type II adhesives.

B. Fire Rated Doors: Provide construction and core specified above as needed to provide fire ratings indicated. Doors must be "true" stile and rail construction. "Simulated" or "sketch-faced" veneer faces are not acceptable.
   1. Interior Fire Rated Doors (20-minute rating): Fire rated doors with 1-3/4" thick stiles and rails complying with requirements indicated for interior doors.

2.02 STILE AND RAIL DOORS FOR TRANSPARENT FINISH - INTERIOR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:
   1. The Maiman Company (Basis of Design).
   2. Algoma Hardwoods, Inc.
   3. Eggers Industries.

B. Interior Solid Core Doors:
   1. Stile and Rail Construction: Veneered, minimum 1/16" before sanding; structural engineered core; edgebands same species as face veneer.
   2. Wood Species for Transparent Species: Mahogany.
      a. Cut: Quarter sawn.
   3. Size, Layout, and Thickness: As indicated on Drawings.
   4. Sticking Design (typical ALL doors): equal to Maiman's 0.375" ovolo sticking.

2.03 FABRICATION

A. Fabricate stile and rail wood doors in sizes indicated.

B. Fit doors to suit frame opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise

indicated.
1. Comply with requirements in NFPA 80 for fire rated doors.

C. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.

2.04 FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including machining for hardware that is not surface applied, before finishing.

B. Door for Transparent Finish: Stain doors (if required) to match existing doors. Provide a clear protective coating over the wood veneer allowing the natural color and grain of the selected wood species to provide the appearance specified.
1. Grade: Premium.
2. Finish: Meet or exceed WDMA TR6 Catalyzed Polyurethane finish performance requirements.
3. Staining: Custom color as required. Match existing doors in the building.

## PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine doors and installed door frames before hanging doors.
1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.02 INSTALLATION

A. Hardware: For installation, see Section 08710.

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.

C. Job-fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated. Do not trim stiles and rails in excess of limits set by manufacturer or as permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
1. Clearances: Provide 1/8" at heads, jambs, and between pairs of doors. Provide 1/8" from bottom of door to top of decorative floor finish or

covering. Where threshold is shown or scheduled, provide 1/4" from bottom of door to top of threshold. Bevel non-rated doors 1/8" in 2" (3-1/2 degrees) at lock and hinge edges.

2. Comply with NFPA 80 for fire rated doors.

D. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.03 ADJUSTING

A. Operation: Re-hang or replace doors that do not swing or operate freely.

B. Replace doors 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

SECTION 08 31 00 - ACCESS DOORS

## PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope: Furnish and install flush panel access doors (non-rated) at public restrooms where shown on the Drawings and as herein specified.

B. Related work specified elsewhere:
1. Division 9 - Finishes.

1.02 SUBMIMTTALS

A. Submit shop drawings and product data to Architect for approval, prior to purchase of access doors.

## PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Access doors for installation in walls shall be equal to the products of Milcor LP, Lima, OH 45805. Telephone 1-800-528-1411.

2.02 ACCESS DOORS AT TILE WALLS (PUBLIC RESTROOMS)

A. Door shall be equal to Milcor Style "MS", #3202-424, with masonry anchors for masonry application. 90-minute UL rated.

B. Door panel and frame shall be 16-gauge stainless steel. Nominal size: 18"x18".

C. Hinges shall be concealed spring hinges open to 175 degrees, with removable pin.

D. Locks shall be flush, screwdriver-operated with steel cam.

## PART 3 - EXECUTION

3.01 INSTALLATION

A. Access doors shall be installed plumb, level and/or square with adjacent surfaces. Provide appropriate concealed anchors, hangers and/or fasteners as recommended by the manufacturer and as required for a secure installation.

END OF SECTION

SECTION 08 41 26 – ALL-GLASS ENTRANCES

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Furnish and install all-glass entrances and panels as shown on the Drawings. Furnish and install metal glazing channels and miscellaneous hardware.

B. Related work specified elsewhere:
1. Section 06 01 10 – Rough Carpentry.
2. Section 07 90 00 – Sealants and Caulking.
3. Section 08 71 00 – Finish Hardware.
4. Section 08 81 00 – Glass Glazing.
5. Section 09 29 00 – Gypsum Board.

### 1.02 REFERENCES

A. Conform to the standards, specifications, codes, laws, and references listed hereinafter.

B. Aluminum Association (AA):
1. Designation System for Aluminum Finishes.

C. American Architectural Manufacturers Association (AAMA):
1. 2605 Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
2. 606.1 Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum.
3. 607.1 Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
4. 608.1 Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.
5. 701.2 Specifications for Pile Weatherstripping.
6. Manual#10 Care and Handling of Architectural Aluminum From Shop to Site.
7. SFM-1 Aluminum Storefront and Entrance Manual.

D. American National Standards Institute (ANSI):
1. Z97.1 Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.

E. American Society for Testing and Materials (ASTM):
1. A167 Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. B36 Brass Plate, Sheet, Strip, and Rolled Bar.
3. B221 Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
4. C920
5. C1036 Flat Glass.
6. C1048

F. Consumer Product Safety Commission (CPSC):
1. 16CFR 1201 Safety Standard for Architectural Glazing Materials.

G. Copper Development Association, Inc. (CDA):

1. 405/7R Copper Brass Bronze Design Handbook; Architectural Applications.

H. Flat Glass Marketing Association (FGMA):
1. Glazing Manual.

I. National Association of Architectural Metal Manufacturers (NAAMM):
1. AMP 502 Finishes for Copper Alloys.
2. AMP 503 Finishes for Stainless Steel.

1.03 SYSTEM REQUIREMENTS

A. Design and Performance Requirements:
1. Drawings are diagrammatic and do not purport to identify nor solve problems of thermal or structural movement, glazing, anchorage, or moisture disposal.
2. Requirements shown by details are intended to establish basic dimension of units, sight lines and profiles of members.
3. Provide concealed fastening wherever practicable.
4. Systems manufacturer is responsible for design and engineering of all-glass entrances, including verification of glass thicknesses specified, and necessary modifications to meet specified requirements and maintaining visual design concepts.
5. Attachment considerations are to take into account site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening, or fracturing connection between units and building structure or between unites themselves.
6. Design anchors, fasteners and braces to be structurally stressed not more than 50% of allowable stress when maximum loads are applied.
7. Provide for expansion and contraction due to structural movement without detriment to appearance or performance.
8. Comply with CPSC 16 CFR 1201 and ANSI Z97.1 for safety requirements of glazing materials.

1.04 SUBMITTALS

A. General: Submit in accordance with Section 01 34 00.

B. Product Data:
1. Submit manufacturer's descriptive literature and product specifications.
2. Include information for factory finishes, hardware, sealants, accessories and other required components.
3. Include color charts for finish indicating manufacturer's standard colors available for selection.

C. Shop Drawings:
1. Submit shop drawings indicating design, fabrication and installation of systems.
2. Show anchors, joint systems, expansion and contraction provisions and other components no included in manufacturer's standard data.
3. Include wall elevations, typical unit elevations and detail sections.
4. Include glazing, hardware and anchorage details.
5. Clearly indicate locations of exposed fasteners.

D. Samples:

1. Submit samples indicating quality of finish (in required colors) on alloys used for work, MFG STD for extrusions and 3 inches square for sheet materials.
2. Where normal color and texture variations are expected, include additional samples to show range of such variations.
3. Submit samples for each type of glass, 12" x 12" size.

E. Certificates:
1. Submit manufacturer's certification stating that systems are in compliance with specified requirements.

F. Qualification Data:
1. If requested by Architect, submit manufacturer qualifications verifying years of experience; include list of projects having similar scope of work identified by name, location, date, reference name and phone number.

1.05 QUALITY ASSURANCE

A. Single Source Responsibility:
1. To ensure quality of appearance and performance, obtain materials for systems from either a single manufacturer or from manufacturer approved by systems manufacturer.

B. Manufacturer Qualifications: Not fewer than 5 years of successful experience in engineering, production and fabrication of entrance systems.

C. Perform Work in accordance with AAMA SFM-1 and manufacturer's written instructions.

D. Conform to requirements of ANSI A117.1 and local amendments.

E. Manufacturer shall engineer system of glass sizes indicated on Drawings, providing adequate support members as required for the system indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 01600.

B. Protect finish surfaces as necessary to prevent damage.

C. Do not leave coating residue on any surface.

D. Replace damaged units.

E. Deliver glass with manufacturer's labels intact. Labels are required to indicate glass thickness, unit location, glass strength and orientation of units in vertical position.

F. Protect glass edges and corners against chipping and cracking.

1.07 WARRANTY

A. Provide warranties in accordance with Section 01 70 00.

B. Provide written warranty in form acceptable to Owner jointly signed by manufacturer, installer and Contractor warranting work to be free from defective materials, defective workmanship, glass breakage due to defective design, and agreeing to replace components which fail within two (2) years from date of Final Project Acceptance.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. OldCastle Building Envelope, Terrell, TX, ph 972-551-6114, or equal.

B. It is intended that a single manufacturer shop-fabricate the entire glazing system, comprised of the components specified below, and ship to job ready for installation.

### 2.02 MATERIALS AND COMPONENTS

A. Clear Tempered Glass:
   1. Quality: ASTM C1036, Type I transparent flat, Class 1 clear, Quality q3 glazing select.
   2. Type: ASTM C1048, fully tempered, with tongless horizontal tempering.
   3. Exposed edges: polished smooth.
   4. Thickness: 1/2" thick (Glass Type 3).

B. Sidelight fittings: Full rails, top and bottom, full width of sidelights (Window Type "A").
   1. Profile: Square design.
   2. Bottom rail: Equal to C.R. Laurence shallow U-channel catalog #SCSA3812SL. Provide end caps at all rail terminations-- C.R. Laurence end cap catalog #UCECSA. Provide snap-in filler caps where shown on Drawings, catalog #NHF12SA.
   3. Top Rail: Equal to C.R. Laurence U-channel catalog #UCSA3812240. Provide end caps at all rail terminations-- C.R. Laurence end cap catalog #UCECSA. Provide snap-in filler caps where shown on Drawings, catalog #NHF12SA.
   4. Finish for all framing members shall be dark bronze, similar to US10B.

C. Door Fittings:
   1. Patch fitting at top equal to Dorma "Universal PT-22"; patch fitting at bottom equal to Dorma "Universal PT-10" with 355.6 floor bearing.
   2. Ceiling-concealed door closer: equal to Dorma "RTS88" with 5 mm extension, 1.5" deep (body) for recessed/flush mounting, including mounting brackets and #8561 cover.
   3. Surface-mount magnetic lock: equal to Schlage M492 with HDB door bracket and power supply PS902.
   4. All hardware finish shall be Dark Bronze Anodized (108).

D. Door handles: Equal to Rockwood RM5532, 1-7/8" x 7-1/2” traditional cast pull. Finish: US10B.

E. Glass fins: Glass thickness shall be engineered by manufacturer so as not to require glass fin supports.

F. Glazing Sealant:
   1. Type: Silicone, one-part, conforming to ASTM C920, Type S, Grade NS.
   2. Colors: Custom as selected by Architect.
   3. Primer: When required by sealant manufacturer, type as recommended.
   4. Acceptable product (glass to glass):
      a. 999 Silicone Building and Glazing Sealant, Dow Corning Corp., Midland, MI.
      b. Silglaze N, General Electric Co., Waterford, NY.
   5. Acceptable products (glass to metal):
      a. 795 Silicone Building Sealant, Dow Corning Corp., Midland, MI.
      b. Silpruf, General Electric Co., Waterford, NY.

G. Sealant Backer Rod: Type as recommended by sealant manufacturer.

H. Glazing Gaskets, Tapes, Setting Blocks, Edge Blocks and Spacers:
   1. Types and sizes recommended by system manufacturer.
   2. Compatible with silicone glazing sealant when in contact with each other.

I. Fasteners:
   1. Provide concealed fasteners wherever possible.
   2. For exposed locations, provide Phillips flathead screws with finish matching item fastened.
   3. For concealed locations, provide manufacturer's standard.

2.03 SYSTEM FINISH

A. Oil rubbed bronze US10B.

## PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instruction, details and approved shop drawings, and per AAMA SFM-1.

B. Erect true to line, plumb, level, square and in proper planes with other work, free from twists, sags, waves, buckles or other objectionable defects.

C. Provide anchorage to safely resist stresses to which members will normally be subjected.

D. Sawcut slab as required to recess bottom channels flush with terrazzo; sawcut slab to recess door closers, pouring 8" slab into cutout doweling into cutout, doweling into existing slab.

E. Anchor securely in place allowing for required movement including expansion and contraction.

F. Separate dissimilar materials at contact point, including metal in contact with masonry or concrete surfaces, with bituminous paint or preformed separators to prevent contact and corrosion.

G. Glazing Sealant Application:

1. Follow sealant manufacturer's surface preparation and application instructions without exception.
2. Ensure sealant bonding surfaces are sound, clean, dry and free of contamination.
3. Clean glass edges and surfaces in contact with glazing sealant with cleaner recommended by manufacturer.
4. Mask areas adjacent to joints if necessary to obtain neat sealant line.
5. Tool sealant concave and remove masking tape immediately.
6. Clean excess sealant from adjacent surfaces while in uncured stage with recommended solvent.

H. Door Edge Clearances:
1. Between doors and frame at head and jambs: 1/8".
2. At sills with thresholds: 1/4".
3. At sills without thresholds: 1/2".
4. At meeting edges of pairs of doors: 1/8".

3.02 ADJUSTING

A. Test door operating functions. Adjust closing and latching speeds and other hardware in accordance with manufacturer's instructions to ensure smooth operation.

3.03 CLEANING

A. Clean surfaces in compliance with manufacturer's recommendations; remove excess mastic, mastic smears, foreign materials and other unsightly marks.

B. Remove protective paper. Clean surfaces and polish to uniform luster. Exercise care to avoid damage of finishes.

C. Wash glass on interior and exterior to remove paint, soil, prints, and foreign matter. Clean glass only with mild detergent and water following glass manufacturer's instructions. Do not use abrasive materials.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

## 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.

### 1.2 SUMMARY

A. This Section includes commercial door hardware for the following:
   1. Swinging doors.
   2. Sliding doors.
   3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:
   1. Mechanical door hardware.
   2. Electromechanical door hardware.
   3. Cylinders specified for doors in other sections.

C. Related Sections:
   1. Division 08 Section "Hollow Metal Doors and Frames".
   2. Division 08 Section "Flush Wood Doors".
   3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
   1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
   2. ICC/IBC - International Building Code.
   3. NFPA 70 - National Electrical Code.
   4. NFPA 80 - Fire Doors and Windows.
   5. NFPA 101 - Life Safety Code.
   6. NFPA 105 - Installation of Smoke Door Assemblies.
   7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
   1. ANSI/BHMA Certified Product Standards - A156 Series.
   2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
   3. ANSI/UL 294 - Access Control System Units.
   4. UL 305 - Panic Hardware.

5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
   2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
   3. Content: Include the following information:
      a. Type, style, function, size, label, hand, and finish of each door hardware item.
      b. Manufacturer of each item.
      c. Fastenings and other pertinent information.
      d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
      e. Explanation of abbreviations, symbols, and codes contained in schedule.
      f. Mounting locations for door hardware.
      g. Door and frame sizes and materials.
      h. Warranty information for each product.
   4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:
   1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling,

monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

G. ASSURANCE

H. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

I. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

J. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

K. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

L. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
   1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
   2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

M. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

N. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
   1. Function of building, purpose of each area and degree of security required.
   2. Plans for existing and future key system expansion.
   3. Requirements for key control storage and software.
   4. Installation of permanent keys, cylinder cores and software.
   5. Address and requirements for delivery of keys.

O. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
   1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation

manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

P. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

## 1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

## 1.5 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.6 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
   1. Structural failures including excessive deflection, cracking, or breakage.
   2. Faulty operation of the hardware.
   3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:
   1. Ten years for mortise locks and latches.
   2. Twenty five years for manual overhead door closer bodies.
   3. Two years for electromechanical door hardware.

1.7 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at

the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

## 2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:
   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
   a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
   a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
5. Manufacturers:

a. Hager Companies (HA).
b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
c. Stanley Hardware (ST).

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
1. Manufacturers:
a. Hager Companies (HA) - ETW-QC (# wires) Option.
b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - QC (# wires) Option.
c. Stanley Hardware (ST) - C Option.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
1. Provide one each of the following tools as part of the base bid contract:
a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.
b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.
2. Manufacturers:
a. Hager Companies (HA) - Quick Connect.
b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - QC-C Series.
c. Stanley Hardware (ST) - WH Series.

2.4 DOOR OPERATING TRIM

A. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware

Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
5. Manufacturers:
   a. Hiawatha, Inc. (HI).
   b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
   c. Trimco (TC).

## 2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
   1. Threaded mortise cylinders with rings and cams to suit hardware application.
   2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
   3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
   4. Tubular deadlocks and other auxiliary locks.
   5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
   6. Keyway: Manufacturer’s Standard.

C. Keying System: Each type of lock and cylinders to be factory keyed.
   1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
   2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
   3. Existing System: Field verify and key cylinders to match Owner's existing system.

D. Key Quantity: Provide the following minimum number of keys:
   1. Change Keys per Cylinder: Two (2)
   2. Master Keys (per Master Key Level/Group): Five (5).
   3. Construction Keys (where required): Ten (10).

E. Construction Keying: Provide construction master keyed cylinders.

F. Key Registration List (Bitting List):
   1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
   2. Provide transcript list in writing or electronic file as directed by the Owner.

## 2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
   1. Manufacturers:
      a. Corbin Russwin Hardware (RU) - ML2000 Series.
      b. Sargent Manufacturing (SA) - 8200 Series.
      c. Yale Commercial(YA) - 8800FL Series.

## 2.7 ELECTROMECHANICAL LOCKING DEVICES

A. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed, subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below and in the hardware sets.
   1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.
   2. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
   3. Manufacturers:
      a. Corbin Russwin Hardware (RU) - ML20900 Series.
      b. Sargent Manufacturing (SA) - 8200 Series.
      c. Yale Commercial(YA) - 8800FL Series.

## 2.8 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
   3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
   4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:
   1. Strikes for Mortise Locks and Latches: BHMA A156.13.
   2. Strikes for Bored Locks and Latches: BHMA A156.2.
   3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
   4. Dustproof Strikes: BHMA A156.16.

## 2.9 ELECTRIC STRIKES

A. Standard Electric Strikes: Electric strikes tested to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 1 million operating cycles. Provide strikes with 12 or 24 VDC capability, fail-secure unless otherwise specified. Where specified provide latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.
   1. Manufacturers:
      a. HES (HS) - 1006 Series.

B. Surface Mounted Rim Electric Strikes: Surface mounted rim exit device electric strikes tested to ANSI/BHMA A156.31, Grade 1, and UL Listed for both Burglary Resistance and for use on fire rated door assemblies. Construction includes internally mounted solenoid with two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Strikes tested for a minimum of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike. Strike requires no cutting to the jamb prior to installation.
   1. Manufacturers:

a. HES (HS) - 9400/9500/9600/9700/9800 Series.

C. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

## 2.10 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:
   1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
   2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
   3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
   4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
   5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
   6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
   1. Manufacturers:
      a. Corbin Russwin Hardware (RU) - DC6000 Series.
      b. Norton Door Controls (NO) - 7500 Series.
      c. Sargent Manufacturing (SA) - 351 Series.
      d. Yale Commercial(YA) - 4400 Series.

## 2.11 ARCHITECTURAL TRIM

A. Door Protective Trim
   1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
   2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
   3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.
   4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
      a. Stainless Steel: 300 grade, 050-inch thick.
   5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
   6. Manufacturers:
      a. Hiawatha, Inc. (HI).
      b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
      c. Trimco (TC).

## 2.12 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
   1. Manufacturers:
      a. Hiawatha, Inc. (HI).
      b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
      c. Trimco (TC).

2.13 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
   1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
   1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:
   1. National Guard Products (NG).
   2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
   3. Reese Enterprises, Inc. (RE).

2.14 ELECTRONIC ACCESSORIES

A. s125 kHz proximity technology and interface with the access control reader modules and door control hardware devices as specified. Card readers to meet the following, minimum, design and performance specifications.
   1. Reader to operate on 12VDC or 5VDC power from the reader I/O modules at a maximum current rating of 150 mA per reader.

2. Reader to be weatherproof type when installed in exterior or other wet environments.
3. Reader to communicate with the reader I/O modules using industry standard Wiegand protocol interface.
4. Reader to have multi-color LED display and audible status indications.
5. Reader type and model to meet the design and mounting applications needs of each entry point as indicated on the drawings.
6. Manufacturers (125 kHz Proximity):
   a. Corbin Russwin Hardware (RU) - 752F909/751F929 Series.
   b. HID Global (HG) - MiniProx 5365/ProxPro ll 5455 Series.
   c. Sargent Manufacturing (SA) - 4302/4304 Series.

B. Linear Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw plus 50% for the specified electrified hardware and access control equipment.
1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
2. Manufacturers:
   a. Alarm Controls (AK) - APS Series.
   b. Securitron (SU) - BPS Series.

## 2.15 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

## 2.16 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### 3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

### 3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
   1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
   1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
   2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
   3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
   4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

## 3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
   1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

## 3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

## 3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

## 3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

## 3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
   1. Quantities listed are for each pair of doors, or for each single door.
   2. The supplier is responsible for handing and sizing all products.
   3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
   4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

**Hardware Sets**

**Set: 1.0**

Doors: 18, 46

Description: PP

| | | | | |
|---|---|---|---|---|
| 3 | Hinge, Full Mortise | TA2714 4-1/2" x 4-1/2" | US10B | MK |
| 1 | Pull Plate | BF 110 x 70C | US32D | RO |
| 1 | Push Plate | 70C | US32D | RO |
| 1 | Surface Closer | 351 O | EB | SA |
| 1 | Kick Plate | K1050 10" X 1.5" LDW | US10B | RO |

| | | | | |
|---|---|---|---|---|
| 1 | Gasketing | PK33D -HEAD & JAMBS | | PE |

**Set: 2.0**

Doors: 13, 14, 42, 43

Description: PASS - OHS

| | | | | |
|---|---|---|---|---|
| 3 | Hinge, Full Mortise | TA2714 4-1/2" x 4-1/2" | US10B | MK |
| 1 | Passage Set | 8215 WTA | US10B | SA |
| 1 | Door Closer | 351 CPS | US10B | SA |
| 1 | Kick Plate | K1050 10" X 1.5" LDW | US10B | RO |
| 1 | Gasketing | PK33D -HEAD & JAMBS | | PE |

**Set: 3.0**

Doors: 39, 40

Description: ENTRY

| | | | | |
|---|---|---|---|---|
| 3 | Hinge, Full Mortise | TA2714 4-1/2" x 4-1/2" | US10B | MK |
| 1 | Office/Entry Lock | 21 8255 WTA | US10B | SA |
| 1 | Surface Closer | 351 O | EB | SA |
| 1 | Kick Plate | K1050 10" X 1.5" LDW | US10B | RO |
| 1 | Wall Stop | 409 | US10BE | RO |
| 1 | Gasketing | PK33D -HEAD & JAMBS | | PE |

**Set: 4.0**

Doors: 21, 23, 33, 50, 52, 9

Description: STOREROOM

| | | | | |
|---|---|---|---|---|
| 3 | Hinge, Full Mortise | TA2714 4-1/2" x 4-1/2" | US10B | MK |
| 1 | Storeroom Lock | 21 8204 WTA GMK | US10B | SA |
| 1 | Wall Stop | 409 | US10BE | RO |
| 1 | Gasketing | PK33D -HEAD & JAMBS | | PE |

**Set: 5.0**

Doors: 12, 15, 17, 41, 44, 47

Description: STOREROOM - RATED

| | | | | |
|---|---|---|---|---|
| 3 | Hinge, Full Mortise | TA2714 4-1/2" x 4-1/2" | US10B | MK |
| 1 | Storeroom Lock | 21 8204 WTA GMK | US10B | SA |
| 1 | Surface Closer | 351 O | EB | SA |
| 1 | Kick Plate | K1050 10" X 1.5" LDW | US10B | RO |
| 1 | Wall Stop | 409 | US10BE | RO |
| 1 | Gasketing | PK33D -HEAD & JAMBS | | PE |

**Set: 6.0**

Doors: 1, 2, 22, 24, 25, 26, 27, 28, 29, 3, 30, 32, 34, 35, 36, 37, 38, 4, 5,

51, 53, 54, 55, 56, 57, 6, 7, 8

Description: OFFICE

| | | | | | |
|---|---|---|---|---|---|
| 3 | Hinge, Full Mortise | TA2714 4-1/2" x 4-1/2" | US10B | MK | |
| 1 | Office/Entry Lock | 21 8255 WTA | US10B | SA | |
| 1 | Wall Stop | 409 | US10BE | RO | |
| 1 | Gasketing | PK33D -HEAD & JAMBS | | PE | |

**Set: 7.0**

Doors: 10, 11, 20, 49

Description: NEW - EAC

| | | | | | |
|---|---|---|---|---|---|
| 2 | Hinge, Full Mortise | TA2714 4-1/2" x 4-1/2" | US10B | MK | |
| 1 | Hinge, Full Mortise | TA2714 QC8 4-1/2" x 4-1/2" | US10B | MK | ⚡ |
| 1 | Fail Secure Lock | RX 21 8271-24V WTA | US10B | SA | ⚡ |
| 1 | Door Closer | 351 P10 | US10B | SA | |
| 1 | Kick Plate | K1050 10" X 1.5" LDW | US10B | RO | |
| 1 | ElectroLynx Harness | QC-C1500 [ PS to hinge ] | | MK | ⚡ |
| 1 | ElectroLynx Harness | QC-CXXP [ Lock / exit to hinge ] | | MK | ⚡ |
| 1 | Card Reader | SE RP40 / SE RP15 as req | | | ⚡ |
| 1 | Power Supply | BPS-Series (Volt & Amp as req) | | SU | ⚡ |

Notes: Verify exisitng frame condition at door 10.

**Set: 8.0**

Doors: 16, 45

Description: GLASS - EAC

| | | | | | |
|---|---|---|---|---|---|
| 1 | Card Reader | SE RP40 / SE RP15 as req | | | ⚡ |
| 1 | Push Button | EEB3N | | SU | ⚡ |
| 1 | Power Supply | BPS-Series (Volt & Amp as req) | | SU | ⚡ |

Notes: Mag lock by door supplier

**Set: 9.0**

Doors: 28A, 28B, 58, 59, 63, 67

Description: EXISTING - RIM EXIT - EAC

| | | | | | |
|---|---|---|---|---|---|
| 1 | Electric Strike | 9600 | 613E | HS | ⚡ |
| 1 | SMART Pac Bridge Rectifier | 2005M3 | | HS | ⚡ |
| 1 | Card Reader | SE RP40 / SE RP15 as req | | | ⚡ |

Notes: Field verify existing conditions prior to submittals.

**Set: 10.0**

Doors: 64, 66

Description: EXISTING - PR - SVR - EXITS - EAC

| | | | | | |
|---|---|---|---|---|---|
| 1 | SMART Pac Bridge Rectifier | 2005M3 | | HS | ⚡ |
| 1 | Electric Strike | 310-6-8-24D | 612 | FO | ⚡ |
| 1 | Card Reader | SE RP40 / SE RP15 as req | | | ⚡ |

Notes: Field verify existing conditions prior to submittals.

**Set: 11.0**

Doors: 28C, 59A, 59B, 60, 61, 62A, 62B, 65, 68, 69, 70

Description: EXISTING - LOCK - EAC

| | | | | | |
|---|---|---|---|---|---|
| 1 | SMART Pac Bridge Rectifier | 2005M3 | | HS | ⚡ |
| 1 | Electric Strike | 1600-CS | 613E | HS | ⚡ |
| 1 | Card Reader | SE RP40 / SE RP15 as req | | | ⚡ |

Notes: Field verify existing conditions prior to submittals.

END OF SECTION

SECTION 08 81 00 - GLASS AND GLAZING

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Provide the glass and glazing operations as indicated on the Drawings and as specified herein.

B. Related work specified elsewhere:
   1. Section 08 14 33 – Rail and Stile Wood Doors
   2. Section 08 41 26 - All-Glass Entrances

### 1.02 DELIVERY, STORAGE AND HANDLING

A. If glass is delivered to job site for storage prior to installation, deliver in cartons or crates and store so that glass is supported on edges. Do not lay flat.

B. Store glass in enclosed protected area.

C. Keep glass free from contamination by materials capable of staining glass.

D. Deliver glazing compounds and sealants in original unopened containers with labels intact and legible.

E. Store glazing compounds and sealants in same area as glass, off ground, in manner to avoid damage and contamination.

F. Remove damaged or contaminated materials from job site immediately upon discovery.

### 1.03 ENVIRONMENTAL REQUIREMENTS

A. Perform glazing operations only when ambient temperature is 40°F, or above.

B. Perform glazing operations only on dry surfaces.

### 1.04 MANUFACTURER'S WARRANTY

A. Manufacturer's standard one-year warranty, except where longer periods are specified hereinafter, such as for sealed insulating glass units.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Glass: Equal to products of Pilkington North America, Inc., Toledo, OH, ph 419-247-3731.

B. Insulating Glass: Equal to PPG Industries.

C. Glazing tapes and compounds: Equal to products of Tremco and Sarco.

2.02 QUALITY STANDARDS

A. Tempered safety glass shall comply with:
   1. ASTM C 1036 and ASTM C 1048.
   2. ANSI Z97.1.
   3. CPSC Standard 16 CFR 1201.

B. Insulating glass units shall comply with:
   1. ASTM E 774 Class A.

C. Float glass shall comply with:
   1. Federal Specifications DD-G-451d
   2. ASTM C 1036.

D. Laminated safety glass shall comply with:
   1. ASTM C 1036.
   2. ANSI Z97.1.
   3. CPSC Standard 16 CFR 1201 Category I and II.

2.03 MATERIALS

A. Glass #1:
   1. Fire-rated tempered glass sandblasted and wireless glazing material equal to "Fireglass 20", as manufactured by J.R. Four Ltd., and distributed by Technical Glass Products. Glass shall be 1/4" thick, 20-min fire-rated, impact safety-rated toughened glass. Manufacturer shall lightly sandblast the glass on the interior side without affecting the fire rating.

B. Glass #2:
   1. Tempered safety glass with sandblasted (frosted) finish to match Glass Type 1.
   2. 1/4" thickness, glazing quality.

C. Glass #3:
   1. Tempered safety glass equal to Pilkington.
   2. 1/2" thickness, glazing quality, with pencil polished edges.

D. Frameless Mirrors:
   1. 1/4" thick plate float glass with ground and polished edges;
   2. Mirror finish as per U.S. Commercial Standard CS-27-36;
   3. Five-year manufacturer's warranty with coverage for defects in silvering.

E. Setting blocks:
   1. Neoprene, 70-90 durometer hardness
   2. Chemically compatible with materials which it contacts.

F. Spacers:
   1. Neoprene, 40-50 durometer hardness
   2. Chemically compatible with materials which it contacts.

## PART 3 - EXECUTION

### 3.01 INSTALLATION OF GLASS

A. Clean stops, channels and setting areas with methylethylketone.

B. Backbed with glazing tape or glazing compound where required for weatherproof seal.

C. Install glass by pressing firmly into tape or compound and set stops, gaskets or other devices furnished as part of the frame assembly.

D. Install with glass labels intact.

E. Safety and fire-rated glass, tempered as well as laminated, shall be installed so that the permanent, factory-installed, compliance monogram will be visible and easily readable after installation.

F. Except where fully resilient glazing gaskets are furnished, provide a minimum 1/8" thickness of glazing compound between face of stops and each face of glass, particularly assuring that no vibration or rattling occurs in hollow metal sashes that contain operable doors.

### 3.02 PROTECTION

A. Protect all glass and glazing from damage during the construction period.

B. In-place glass in the vicinity of welding activity shall be protected from damage by the welding operations.

C. The Contractor shall replace any in-place glass damaged as a result of the construction operations.

END OF SECTION

SECTION 09 21 00 – LATH AND PLASTER

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Furnish labor, materials, equipment, services, and supervision necessary to provide the lathing and plastering as indicated on the Drawings and specified herein, including patching of existing plaster at "exterior" (north) restroom walls (as substrate for new wall tile).
   1. Match existing adjacent plaster textures.

B. Related work specified elsewhere:
   1. Section 02 05 00 - Demolition
   2. Section 09 29 00 - Gypsum Board
   3. Section 09 91 00 - Painting

### 1.02 REFERENCES

A. Gypsum Construction Handbook, latest edition, United States Gypsum Company.

B. PCA - Portland Cement Association: Portland Cement Plaster (Stucco) Manual.

C. ASTM C 144-89, "Specification for Aggregates for Masonry Mortar"

D. ASTM C 150-89, "Specification for Portland Cement"

### 1.03 SYSTEM DESCRIPTION

A. Required Coats - Three (3) coats regardless of base.

### 1.04 SAMPLES AND MOCKUPS

A. Samples:
   1. Prepare and submit a sample, for approval by Owner and Architect, of textured plaster to match existing. Sample board shall be a minimum of 3’ x 3’.

B. Mock-Ups:
   1. Construct a sample panel of wall plaster approximately 8’ long x 6' height on existing exterior masonry wall where directed by Architect.
      a. Prepare mock-up using self-furring metal lath, trim (including casing beads, edge conditions at dissimilar materials, control joints, etc.), accessories, and 3-coat plaster with sand-finish texture.
      b. Should the first mock-up be rejected, the sample panel shall be reconstructed as many times as is necessary to attain a satisfactory sample. Each sample shall be cured and allowed to dry prior to inspection.
      c. Do not proceed with work until sample plaster panel is approved by Owner and Architect.
      d. The mock-up, upon approval by Architect, shall become part of the final Project and shall be a standard for judging the complete work.

1.05 QUALITY ASSURANCE

A. Manufacturer's Certificate: Certify that products meet or exceed the specified requirements.

B. Plaster Subcontractor: A company specializing in work required by this Section and with a minimum of ten (10) years documented satisfactory experience on comparable projects.

C. Pre-Installation Meeting: Conduct meeting at project site, in accordance with Section 01200 – Project Meetings. Review methods and procedures of lathing and plastering including, but not limited to, the following:
   1. Inspect substrates to receive new plaster.
   2. Review proposed environmental requirements (heat, ventilation, circulation of air, and humidity control).

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver all manufactured materials in the original packages, containers, or bundles and bearing the name of the manufacturer and the brand. Except as otherwise indicated, the mixing, installation and application of manufactured material shall be in strict accordance with the printed directions of the manufacturer.

B. Protect plaster, lath and all cementitious materials against dampness until used. Store materials off the ground or floor, under cover and away from sweating walls and other damp surfaces. Protect metal lath and accessories in the work.

1.07 PROJECT/SITE CONDITIONS

A. Environmental Requirements:
   1. Maintain a minimum temperature of 55 degrees F. in spaces to be plastered for at least 7 days prior to plastering, during plastering, and until plaster has cured. Protect plaster from freezing and from uneven or too rapid drying. After plaster has set hard, provide and maintain free circulation of air to prevent sweatouts.
   2. Provide adequate heat, ventilation, circulation of air, and humidity control to allow proper drying and curing of plaster.
      a. Drying too slowly will produce "sweatout", a defective condition of the plaster that requires removal and replacement.
      b. Drying too rapidly will produce "dryout", a defective condition of the plaster that requires extensive repair.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Bonding Agent: Shall be equal to "Plaster-Weld", product of Larsen Products Corporation, ph 800-633-6668.
   1. Bonding agent's tensile bond strength shall be an average of 304 psi, after 28 days, and comply with ASTM C631.
      a. Bonding agent is required on concrete, masonry, and plaster substrates that are to receive new plaster patching (after removal of existing wall tile by Contractor).

B. Metal Beads: Shall be equal to products of AMICO (Alabama Metal Industries Corp.), ph 800-366-2642.
   1. Casing bead shall be No. X-66 galvanized expanded flange type, typically for ¾" thick plaster, but size may vary as required to match existing job conditions and thicknesses of new plaster.
      a. Use at control joints (back-to-back, with joint for sealant, as detailed), at termination of new plaster against dissimilar materials, and where indicated on the Drawings.
   2. Corner bead shall be No. X-1 galvanized expanded flange small nose type.
      a. Use at typical outside corner of plaster installation, unless otherwise detailed.

C. Metal Lath: Shall comply with ASTM C847 and A653, and equal to products of AMICO (Alabama Metal Industries Corp.), ph 800-366-2642.
   1. Metal lath shall be galvanized diamond mesh self-furring type, weighing 3.4 lbs./square yard.
      a. Metal lath is required at certain existing interior masonry walls and new masonry infill.
   2. Metal smoothedge cornerlath shall be galvanized diamond mesh, 3" x 3", weighing 2.5 lbs./square yard.
      a. Cornerlath is required at inside corners of walls to be plastered.
   3. Metal smoothedge striplath shall be galvanized diamond mesh, 6" wide strips, weighing 2.5 lbs./square yard.
      a. Striplath is required over joints between existing masonry and new masonry infill.

D. Cementitious Materials:
   1. Plaster: Gypsum gauging plaster, wood fibered gypsum plaster, Keene's cement, hydrated lime, and lime putty shall be equal to standard products of United States Gypsum Company.
   2. Cementitious materials -
      a. Portland cement: ASTM C150, Type 1, gray.
      b. Hydrated finishing lime: ASTM C206, Type S.
   3. Equal to products of Western Lime and Lhoist North America.

E. Aggregate: Plaster - sand shall be clean and comply with ASTM C35. Portland cement plaster stucco – conforming to ASTM C897; scratch coat, sand well graded from fine to coarse; finish coat, light colored silica sand, graded to pass No. 16 mesh sieve.

F. Reinforcement fibers shall conform to ASTM C1116.
   1. Fibers shall be 100% virgin polypropylene in collated, fibrillated form, equal to "Grace Fibers". Fibers shall be 1/2" long, alkali resistant, non-absorptive, and completely non-corrosive.

G. Water: Shall be clean, fresh, suitable for drinking, and free from mineral and organic substances which would affect plaster set.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Verify that substrates to receive plaster are acceptable. Starting work shall indicate acceptance of existing conditions.

B. Check substrates for defects. Do not apply plaster until such defects are corrected. Clean existing masonry of all biological growth and debris prior to installing bond coat.

3.02 PREPARATION

A. Protection: Adequately protect adjacent finish materials against damage from operations of this Section.

B. Surface Preparation:
1. Refer to Drawings for typical detail of where new plaster joins existing, and the preparation required for bridging different masonry substrates.
2. Apply bonding agent, as hereinafter specified.

3.03 APPLICATION/INSTALLATION (PLASTER)

A. Metal Beads Installation:
1. Metal beads and trim shapes shall be installed straight, true, plumb, securely anchored and wire tied to metal lath. Corners shall be neatly cut and fitted. Joints shall be properly aligned and closely butted.
2. Install casing beads by securing to existing structural glazed tile walls, including new masonry infill, at mortar joints. Casing beads shall be secured tight against the masonry substrate using approved anchors spaced a minimum of 12” o.c.
3. Refer to the Drawings for detail of typical control joint consisting of two casing beads installed back-to-back, with joint for sealant. Metal lath shall be interrupted at control joint locations.

B. Metal Lath Installation:
1. Install self-furring lath with sheets running horizontally and with edges/ends lapped as recommended by lath manufacturer. All laps in lath (including expanded lath flanges of casing beads, cornerlath, striplath, etc.) shall be wire tied at intervals not to exceed 9” o.c.
2. Secure self-furring lath to existing interior masonry walls and new masonry infill with stub nails or other approved fasteners, as follows:
   a. Existing interior masonry walls and new infill CMU masonry: Space fasteners 12” o.c. horizontally and 8” o.c. vertically (each bed joint of masonry).
3. Cut back existing plaster on adjacent walls and install 6” wide striplath centered over joints between existing masonry and new masonry infill, and secure with fasteners at 8" o.c.

C. Bonding Agent Application (at exterior masonry walls):
1. Sweep or blow masonry substrates as required to remove dust and loose material.
2. Apply the bonding agent uniformly to masonry substrates using brush, roller or spray to form a continuous pink film over the entire surface. Coverage shall be 300-400 square feet per gallon. Allow to dry not less than one hour before applying plaster scratch coat.

D. Plaster Mixing:
1. Plaster shall be mixed in mechanical type mixer. Measurements shall be by volume or weight as specified. Do not use any frozen, caked, or lumpy materials, or material that has partially set. Retempered plaster that has partially set shall not be used.

2. Clean the mixer of all set or hardened material before materials for a new batch are loaded. Keep mixing tools and equipment clean. Mix each batch separately.
3. The mixing sequence and cycle of operations and time shall be in accordance with the material manufacturer's printed instructions.

E. Plaster Thicknesses:
1. All plaster applications shall be 3-coat work.
2. The total thickness of 3-coat plaster work when measured from face of lath or face of masonry base shall be as follows:
   a. Gypsum plaster on metal lath: 3/4" minimum (match existing).
   b. Gypsum-sand plaster on masonry base: 3/4".
   c. Portland cement lime plaster: As required to match existing conditions.

F. Plaster Base Coats:
1. Exterior walls (interior face):
   a. Portland cement lime plaster base coats are required where indicated on the Drawings and for miscellaneous plaster patching at exterior masonry walls. Mixes shall be proportioned as follows:
      1) Scratch coat: 1 sack Portland cement
         2 sacks hydrated finishing lime (Type "S")
         7-1/2 cu. ft. sand
         2# fiber
      2) Brown coat: 1 sack Portland cement
         2 sacks hydrated finishing lime (Type "S")
         9 cu. ft. sand
2. Interior Walls:
   a. Gypsum-sand plaster base coats on lath and metal studs are required where indicated on Drawings and for miscellaneous plaster patching. Mixes shall be proportioned as follows:
      1) Scratch coat: 100# of wood fibered gypsum plaster
         1 cu. ft. sand.
      2) Brown coat: Same mix as for scratch coat.

G. Base Coat Application:
1. Apply scratch (first) coat with sufficient materials and pressure to adhere firmly to lath or masonry base. Prior to final set, scratch with a scratcher to produce a suitable bond for the next coat.
2. Apply brown (second) coat to true planes and screed in both directions to within 1/16" – 1/8" of finished surface; float and leave rough to receive finish coat. Gypsum scratch coat must be dry before brown coat is applied.
3. Doubling back with brown coat over scratch coat before it is partially dry and set will not be permitted.
4. Portland cement lime plaster base coat plaster shall be cured with controlled water spray 2 days for scratch coat and 5 days for brown coat.

H. Lime Putty:
1. Lime shall be machine mixed with approximately 5-1/2 to 6 gallons of water per 50# bag.

I. Plaster Finish Coats – Types, Mixes, and Locations:
1. Portland cement finish coat shall be applied over Portland cement lime plaster base coats. Finish coat shall be proportioned 1 sack Portland

cement to 300# sand. Lime may be added as a plasticizer in amounts up to 10% by weight of Portland cement if dry hydrate, or 25% by column of Portland cement if putty.

2. Gypsum smooth coat trowel finish shall be applied over gypsum plaster brown coat. Finish coat shall be 1 part gypsum gauging plaster and 2 parts lime putty (dry weight).
3. Keene's cement textured float finish shall be applied over gypsum brown coat. Finish coat shall be 100 lbs. Keene's cement, 50 lbs. dry hydrated lime, and approximately 400 lbs. sand (gradation and amount of sand will vary as required to match the approved sand finish sample).
    a. This textured finish occurs where required to match existing adjacent texture.

J. Finish Coat Application:
1. The thickness of finish coats shall be from 1/16" to 1/8". Apply finish coats to a partially dry brown coat or to a thoroughly dry brown coat that has been evenly wetted; the use of excessive water shall be avoided.
2. Gypsum smooth coat trowel finish coat shall be applied over brown coat to a true, even surface; allow to draw a few minutes and then float and/or steel trowel to a smooth finish free from irregularities and blemishes.
3. Plaster finish coats shall generally be smooth trowel finish, except where a wood float finish may be necessary to match adjacent existing plaster finish which is to remain.
4. Typically above chair rails/wainscotts (except where vinyl wall covering is scheduled), Keene's cement-sand textured float finish coat shall be applied over brown coat to a true, even surface; allow to draw a few minutes and then finish with a wood, cork, rubber, or felt covered float to a uniform texture free from irregularities and blemishes. Final finish shall match the approved sample.

K. Plaster Thicknesses:
1. All plaster applications shall be 3-coat work.
2. The total thickness of 3-coat plaster work when measured from face of lath or face of masonry base shall be as follows:
    a. Gypsum plaster on metal lath: 3/4" minimum (match existing).
    b. Gypsum-sand plaster on masonry base: 3/4".
    c. Portland cement lime plaster: As required to match existing conditions.

L. Plaster Patching:
1. Upon completion, point-up and patch both new plaster and existing plaster to remain. Cut out and patch defective and damaged plaster. Patching of plaster shall match existing work in texture and finish and, at joining with existing or previously applied plaster, shall finish flush and smooth.

## 3.04 CLEANING

A. Maintain neat premises. Leave area broom clean and remove plaster from adjacent floors, etc.

END OF SECTION

SECTION 09 29 00 - GYPSUM BOARD

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Provide gypsum drywall systems as indicated on the Drawings and as specified herein.

B. This Section includes, but is not limited to, the following items of work:
   1. Light gauge steel stud partition and furring systems (for gypsum board and lathed plaster finishes).
   2. Metal suspension and furring systems for drywall ceilings.
   3. Interior drywall finishes, either painted or unpainted.
   4. Acoustical insulation.
   5. Acoustical caulking.

C. Related work specified elsewhere:
   1. Section 09 30 00 – Ceramic Tile.
   2. Section 09 50 00 - Acoustical ceilings.
   3. Section 09 91 00 - Painting.

### 1.02 APPLICATOR

A. The applicator for Work required by this Section shall be an approved drywall subcontractor with full-time drywall business.

B. The applicator shall be acceptable to and be approved by the manufacturer of drywall materials used in the Work.

### 1.03 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Materials shall be delivered in their original unopened packages and stored in an enclosed shelter providing protection from damage and exposure to the elements. Damaged or deteriorated materials shall not be used in the work and shall be removed from the premises.

B. Store wallboard flat, off floor, so that long lengths are not over short lengths.

### 1.04 ENVIRONMENTAL CONDITIONS

A. Building must be completely closed in, with new windows/doors, exterior wall repair, roofing, repair, waterproofing materials, etc., in place before commencement of any gypsum board application. No payment will be rendered by Owner for any gypsum board that is installed outside of the parameters of the environmental conditions specified.

B. In cold weather and during gypsum wallboard application and joint finishing, temperature within the building shall be maintained within the range of 55°-70°F. Provide temporary heat to attain and maintain this temperature range until the permanent heating system is in place, at which time such temperature range shall be maintained by this permanent heating system. Adequate ventilation shall be provided to carry off excess moisture.

C. Do not execute joint treatment operations during periods of high relative humidity.

1.05 QUALITY ASSURANCE

A. The work of this section shall be subject to the commissioning testing described at Section 17800.

1.06 REFERENCES

A. "Recommended Levels of Gypsum Board Finish".

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Materials, assemblies and methods shall generally be those of United States Gypsum Company (USG), as specified, or approved equal. Exception: vaulted ceiling framing at "South Meeting 1201" by other manufacturers as specified.

B. Generally, the materials, assemblies and methods of a single manufacturer shall be used throughout the work.

2.02 PRODUCTS

A. Interior partition framing components:
   1. Steel Studs:
      a. Typical studs shall be full-height ST25. Stud widths as required by Drawings. Studs generally shall be spaced on 24" centers, except where noted otherwise on the Drawings.
      b. Full-height doubled ST20 jamb studs are required at each jamb of openings. Stud widths as required by Drawings. Use 20-gauge studs at 12" o.c. at all cement board walls to receive ceramic or porcelain tile, and all plaster partitions.
   2. Steel runners:
      a. Runners shall be CR25. Runner widths as required by Drawings.
   3. Furring channels: DWC-25 (depth as shown on Drawings).
   4. Material:
      a. Cold-rolled galvanized sheet steel meeting requirements of ASTM A446 and ASTM C645. Galvanizing shall be G40 (.4 ounce/sq. ft.) and minimum yield strength shall be 33,000 psi.

B. Suspended ceiling framing components (at restroom Alcove, Floors 10-11):
   1. Carrying channels shall be cold-rolled steel members weighing not less than 0.475# per square foot, 1-1/2" tall with flanges not less than 7/16" wide, painted finish.
   2. Furring channels: DWC-25, galvanized, roll formed, hat shaped, 7/8" tall.
   3. Hanger wire: No. 8 gauge galvanized steel wire.
   4. Tie wire: No. 16 gauge galvanized steel wire.

C. Gypsum wallboard panels:
   1. Typical wallboard (walls and ceilings, to be of a UL Classified Company):

a. Sheetrock “Mold Tough” panels, 5/8" thick (provide UL-rated Firecode C panels at rated wall conditions).
b. ASTM D3273.
c. Tapered longitudinal edges.

2. Fire-rated wallboard at rated construction:
a. "Mold Tough" Sheetrock Firecode Core C (Type X) panels, 5/8” thick
b. ASTM-C36 (Type X)
c. Tapered longitudinal edges.

D. Fasteners (gypsum board):
1. Runners to concrete slabs and steel members: As recommended by the exterior wall framing material's manufacturer, for 25 psf horizontal loading on the exterior wall.
2. Studs to runners: As recommended by the exterior wall framing material's manufacturer, for 25 psf horizontal loading on the exterior wall.
3. Wallboard to metal studs and metal furring channels:
a. 25 gauge studs - 1-1/8" Type S Bugle Head Screws.
b. 20 gauge studs - 1-1/8" Type S or S-12 Bugle Head Screws.
c. 18 gauge studs - 1-1/8" Type S-12 Bugle Head Screws.

E. Accessories and trim shapes (plastic trim will not be accepted):
1. External corner reinforcement: No.800 Corner Bead.
2. Edge trim: No. 200-A, J-shaped trim, or No. 200-B, L-shaped trim, 5/8" size, as shown on Drawings (all trim shall be floatable).
3. Aluminum Reveal Trims, as manufactured by Fry Reglet Corporation, telephone (800) 237-9773.
a. "Z" Reveal Moulding: Cat. No. DRMZ-625-375 (5/8" x 3/8"), where shown on Drawings.
b. "L" Trim Moulding: Cat. No. DC.2 for 5/8" gyp. bd.

F. Joint finishing:
1. Perf-A-Tape Reinforcing Tape.
2. All-Purpose Ready-Mixed Joint Compound.

G. Acoustical insulation:
1. Thermafiber "Sound Attenuation Fire Blanket” (SAFB unfaced).
2. 3" typical thickness x width to fit stud spacing typical thickness.

H. Acoustical sealant:
1. USG Acoustical Sealant.
2. ASTM C919.

## PART 3 - EXECUTION

### 3.01 PARTITION AND WALL FRAMING INSTALLATION

A. Installation shall be in strict accordance with code requirements and instructions of the materials manufacturer. The following are minimum requirements:
1. Attach steel runners at base and head to structural elements with suitable fasteners located 2" from each end and spaced on 24" centers at interior partitions and on 16" centers at exterior walls.
2. Position studs vertically, engaging base and head runners and spaced typically on 24" centers at interior partitions. All metal studs shall extend unspliced from floor up to the overhead structure. Place studs

in direct contact with all door frame jambs, window jambs, abutting partitions, partition corners and masonry construction elements. Brace studs with kickers at each stud where span is unstable.

3. Anchor all studs to base and ceiling runner flanges with screws through each vertical leg of each runner channel.
4. At framed openings, place horizontally a cut-to-length section of runner, with a web-flange bend at each end, and secure with one screw per flange at interior partitions and two screws per flange at exterior walls. Position a cut-to-length stud (extending to base/head runner) at typical spacing over/under the header.
5. At framed openings (including doors and windows), provide doubled 20-gauge jamb studs at interior partitions.
6. At all gypsum board edge conditions, provide continuous metal stud "blocking" cut between primary studs, or light-gauge metal angles, for anchorage of gypsum board. Under no circumstances shall gypsum board edges not be screwed to metal framing.

3.02 CEILING SUSPENSION SYSTEM INSTALLATION AT ALCOVE DRYWALL CEILINGS (at restroom Alcove, Floors 10 & 11)

A. Installation shall comply with manufacturer's and UL installation instructions for the particular applications required by this Project.
   1. Install carrying channels on 4' maximum centers and within 3" of parallel sidewalls. Hanger wire supports shall be provided along carrying channels, spaced on not more than 4' centers and within 6" of end walls.
   2. Furring channels on 2' maximum centers shall be installed perpendicular to carrying channels and within 3" of parallel walls.
   3. Provide lightgauge metal angles or metal stud blocking for anchorage of gypsum board edges.

3.03 GYPSUM WALLBOARD INSTALLATION

A. Position ends and edges of gypsum wallboard over framing members, except when joints are at right angles to framing members as in horizontal panel application.

B. Stagger end joints in successive courses with joints on opposite sides of a partition placed on different studs.

C. Attach wallboard to framing members with power-driven screws. Space fasteners not less than 3/8" from edges and ends of panels. Drive fasteners in field of wallboard first, working towards ends and edges. Hold wallboard in firm contact with framing while driving fasteners. Wallboard fasteners shall be spaced typically on 12" centers, except as specified in 3.04 K., hereinafter.

D. At free-standing partitions, wallboard on one face of partitions shall extend full-height to the underside of the overhead structure.

E. Wallboard in concealed spaces and wallboard substrate for ceramic tile shall have joints bedded and taped, and screws filled, as a 1-coat joint treatment application. All other joint treatment application shall comply with the manufacturer's detailed instructions for 3-coat joint treatment.

F. At any location where gypsum board comes into contact with another construction material, i.e. wood, masonry, aluminum, steel, etc., the

gypsum board shall be terminated against the dissimilar material with the no.200-A J-trim or 200-B L-trim specified. The joint shall be left dry (no mud or caulk), and shall be cleaned of any such materials that encroach into the joint. Caulk joint half full.

G. Control joints: Install control joints in all gypsum board surfaces, including walls and ceilings, in stairwells, shaft walls, etc., at 30' o.c. maximum, or where shown on Drawings. At non-rated conditions, construct control joints with double studs, providing back-to-back metal trims (200-A or 200-B) as detailed on Drawings, leaving space as detailed between trims. At fire-rated conditions, use USG control joint 093 over double studs at each control joint.

H. Where recessed lighting fixtures, air conditioning diffusers, access panels, etc., occur in wallboard ceilings, the drywall applicator shall be responsible for coordinating the entire ceiling layout and for the correct locations of all openings in such ceilings.

I. Provide hanger wire within 6" of all corners of each recessed light troffer.

J. Install gypsum wallboard and treat joints in accordance with United States Gypsum "Gypsum Construction Handbook", latest edition, and application USG Construction Bulletins or Pamphlets. Gypsum board finish level shall be "Level 5", per "Recommended Levels of Gypsum Board Finish".

K. At acoustical partitions (those with acoustical batts) provide acoustical sealant at floor line, at ends of partition where partition abuts perpendicular partitions, and at perimeter of cut-outs as required to close cracks around outlet boxes, etc.

3.04 FIRE-RESISTIVE CONSTRUCTION

A. Where indicated on Drawings construct UL-rated 1-hour gypsum board partitions, where indicated, as per UL Design U419.

3.05 ACOUSTICAL WALL INSTALLATION

A. At all wall types (see sheet TS) indicating acoustical batts at 3-5/8" stud construcion, such partitions shall be constructed per provisions of SA-870717 to attain an STC rating of 49, to include acoustical batts, acoustical caulk, etc.

3.06 ACOUSTICAL CAULK

A. Install acoustical caulk at all openings and crevices of any partition receiving sound attenuation batts, or elsewhere shown on Drawings.

3.07 ACOUSTICAL INSULATION INSTALLATION

A. At acoustical partitions where shown on Drawings, install insulation blankets (SAB) in accordance with the manufacturer's instructions. Acoustical insulation shall extend the full height of partitions.

B. Tightly butt ends and sides of acoustical insulation blankets within the stud spaces. Cut small pieces of acoustical insulation blankets for

narrow stud spaces, at partition intersections and adjacent to door frames, being careful to completely fill all voids of the hollow metal door frames.

END OF SECTION

SECTION 09 30 00 - CERAMIC TILE AND CUT NATURAL STONE ELEMENTS

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Furnish and install ceramic or porcelain tile, natural stone elements, feather edge cement patching, membrane waterproofing, marble thresholds, and related items, as indicated on the Drawings and herein specified.
   1. Feather edge cement patching material shall be applied to existing floor slabs to provide slope to floor drains. Fluid-applied waterproofing shall be applied over featheredge patching material at all restroom floors, and over (patched) existing plaster substrate at exterior (north) restroom walls, prior to setting tile.
   2. A twenty-five (25) year warranty shall be provided for waterproofing membrane, and all related system components, such as thinset, thickset grout, sealant, featheredge patch, etc. (all such components shall be supplied and warranted by single manufacturer). See 1.09 below.

B. Related work specified elsewhere:
   1. Sealant at control/expansion joints is specified in Section 07 90 00 - Sealants and Caulking.
   2. Division 22 - Floor drains.

### 1.02 REFERENCES

A. Conform to the standards, specifications, codes, laws, and references listed hereinafter.

B. ADA – Americans with Disabilities Act.

C. ANSI - American National Standards Institute:
   1. ANSI A108.1B – Specification for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed.
   2. ANSI A108.5 - Specification for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar.
   3. ANSI A108.10 - Specification for Installation of Grout in Tilework.
   4. ANSI A108.13 - Specification for Installation of Load Bearing, Bonded Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.
   5. ANSI A118.3 - Material Specification for Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive.
   6. ANSI A118.4 - Material Specification for Latex-Portland Cement Mortar.
   7. ANSI A118.6 - Material Specification for Ceramic Tile Grouts.
   8. ANSI A118.10 – Material Specification for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.
   9. ANSI A137.1 - Material Specification for Ceramic Tile.

D. ASTM – American Society for Testing and Materials:
   1. ASTM C 373 - Water Absorption, Bulk Density, Apparent Porosity, and Specific Gravity of Fired Whiteware Products.
   2. ASTM C 1028 – Evaluating the Static Coefficient of Friction of Ceramic and Other Like Surfaces by the Horizontal Dynamometer Pull Meter Method.

E. TCA - Tile Council of America, Inc.
1. Handbook for Ceramic Tile Installation, 2012 edition.

1.03 REGULATORY REQUIREMENTS

A. Comply with all applicable Codes and the requirements of agencies having jurisdiction over the work of this Section.

B. Comply with ADA requirements for Coefficient of Friction when tested in accordance with ASTM C1028.

1.04 QUALITY ASSURANCE

A. Conform to ANSI – American National Standard Specifications for the Installation of Ceramic Tile.

B. Conform to ANSI – Recommended Standard Specifications for Ceramic Tile - TCA 137.1.

C. Master Grade Certificate signed by Tile Manufacturer and Tile Installer.

D. Manufacturer's Certificate: Furnish under Quality Control provisions of Division 1. Certify that products meet or exceed specified requirements.

1.05 SUBMITTALS

A. Submit samples to Architect of each type of ceramic/porcelain tile (including all trim pieces and bases), stone elements (including marble in all specified colors), and grout and mortar specifications and colors required. Samples shall be complete for the patterns and colors manufactured in the types specified. Submit data on the waterproofing membrane(s), featheredge patching, and joint sealants (provide sealant compatibility test report) and grouts specified.

B. Shop drawings: for al stone types and applications, submit shop drawings to include plans, sections, elevations, details, and attachments to other work. Show fabrication and installation details. Include dimensions and profiles of stone units; show locations and details of joints; show locations and details of anchors and supports.

C. Quality Assurance: Submit Master Grade Certificate and Manufacturer's Certificate.

1.06 MOCK-UPS

A. Ceramic floor tile, base, and wall tile: install a 2' x 4' area of 1" x 1" hexagonal ceramic floor tile, extending into a 24" width of ceramic wall tile, to include base and trim pieces, sealant and grout joints, featheredge patch, water-proofing membrane, etc.

B. Construct marble countertop/backsplash mockup, showing all finishes, sealant joints, etc. Approved mockup may become part of the work.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver and store packaged materials in their original unopened containers

with labels intact until time of use. Store and handle materials in a manner to prevent damage or contamination by water, freezing or foreign matter.

B. Keep grade seals intact and cartons dry until tile is used.

1.08 PROJECT/SITE CONDITIONS

A. Environmental Requirements:
   1. Keep area to receive tile work at 50° F minimum for 24 hours before and during preparation of thin-set bed, laying of tile, and for 72 hours after completion of tile work.
   2. Maintain lighting levels at substrate at no less than 50 footcandles (from minimum of two light sources) in areas during installation of materials required by this Section. Increase light levels during work requiring close tolerances.

1.09 WARRANTY

A. The contractor warrants the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for a period of 25 years. The manufacturer of adhesives, mortars, grouts, membranes, and other installation materials shall provide a written twenty five (25) year warranty, which covers materials and labor.

1.10 MAINTENANCE DATA

A. Submit maintenance data under Closeout provisions of Division 1.

B. Include cleaning methods, cleaning solutions recommended, stain removal methods, and polishes and waxes recommended.

1.11 EXTRA MATERIALS

A. Provide Owner with three (3) extra boxes of each ceramic/porcelain tile size and color used, including trim shapes. Provide a minimum of twenty (20) pieces of each trim shape and color used.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Ceramic Floor Tile (restrooms):
   1. Ceramic Floor Tile: 1" x 1" size, hexagon shape, mesh mounted on full sheets, matte finish tiles, less than 0.3% moisture absorption. Install in grid pattern "6006" comprised of 88% "Biscuit" (D317) and 12% "Black" (D311).
      a. Basis of ceramic mosaic floor tile specification shall be "Keystone" series by DalTile.
         1) Color: install in grid pattern "6006" comprised of 88% "Biscuit" (D317) and 12% "Black" (D311).
      b. Approved Manufacturers:
         1) Dal-Tile - Dallas Ceramics, Dallas, TX 800-933-8453.
         2) American Olean Tile Co., Lansdale, PA 215-393-2898
         3) Equal, as approved by Architect.

B. Ceramic Wall Tile (at restrooms):

1. Ceramic wall tile: 3" x 6" size, field tile, semi-gloss finish, less than 20% water absorption.
    a. Basis of ceramic wall tile specification shall be "Rittenhouse Square" by DalTile.
        1) Color shall be No. K101, "White".
        2) Trim:
            a.) 3 x 6 field tile with bull nose finished edges at outside corners.
            b.) 4 x 6 cove base with inside and outside corners
    b. Approved Manufacturers:
        1) Dal-Tile - Dallas Ceramics, Dallas, TX 800-933-8453.
        2) American Olean Tile Co., Lansdale, PA 215-393-2898
        3) Equal, as approved by Architect.

D. Marble (Restroom Vanity Countertops)
1. Polished (all exposed edges and surfaces) "Grafton Cloud Marble" as supplied by Vermont Structural Slate. Comply with recommendations in MIA's "Dimension Stone – Design Manual". Thickness of countertops and backsplashes shall be 1-3/16" (3cm), and edges shall be straight and slightly eased at corners.Shop fabricate all marble for field installation with 1/16" joints at all locations. Shop-cut openings for underhung lavatories using template or pattern furnished by the fixture manufacturer; form cutouts to smooth, even curves. Shop-drill countertops for plumbing fittings, etc.

E. Marble Thresholds -
1. Public Restrooms: White Carrara Marble
2. Honed finish, full width of door opening.
3. Size and profile as shown on Drawings.
Cross-section shall meet (ADA) handicap accessibility requirements.

F. Membrane Waterproofing (typical at all tile floors, and exterior north walls of all restrooms) -
1. "HydroBan", a thin, loadbearing liquid-applied waterproofing/antifracture membrane, consisting of self-curing liquid rubber polymer, exceeding ANSI 118.10 and 118.12. See below related Laticrete products required for the 25-year system warranty (equal complete systems by other manufacturers may be considered).
2. Approved manufacturers:
    a. Laticrete International, Inc., ph 800-243-4788.
    b. Equal, as approved by Architect.

G. Latex-Portland Cement Mortar –
1. Meet requirements of ANSI A118.4 for manufactured mortar, two-part system.
2. Approved systems and manufacturers:
    a. 254 Platinum by Laticrete, or equal.
    b. Equal by C-Cure
    c. Equal by Mapei

H. Tile Grout/Regular -
(For use at Latex-Portland Cement thin-set at tile floors):
1. Meet requirements of ANSI A118.6 for manufactured grout with latex additive.
    a. Color to be selected by Architect.
2. Approved systems and manufacturers:

a. PermaColor (sanded) by Laticrete.
b. Hydroment (sanded) w/#425 admix by Bostik.
c. Ker 200 Series (sanded) w/polymer-modified admix by Mapei.
d. Equal, as approved by Architect.

I. Feather Edge Cement Patching Material -
1. NXT Skim feather edge patch, as manufactured by Laticrete, a premium quallity, Portland cement based patching and underlayment compound.
a. NXT Skim is a smooth, unsanded, fast-setting product that can be skim coated to a feather edge and patched up to 1" thick.

J. Cement Backer Board -
1. Cement Board: DUROCK Cement Board, 5/8" thick, 48" wide x 36" to 96" long.
2. Fasteners: DUROCK Steel Screws, 1-5/8" long for studs.
3. Joint Reinforcement: DUROCK Interior Tape, 2" wide x 50' long.
4. Approved systems and manufacturers:
a. DUROCK, by U.S. Gypsum Company.
b. Equal, as approved by Architect.

K. Stone countertop accessories:
1. General: use only adhesives formulated for stone and recommended by manufacturer for the applications shown on Drawings.
2. Water-cleanable Epoxy Adhesive: ANSI 118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Sealant for countertop joints shall be equal to Latisil. See 07900.
4. Stone Cleaner: Cleaner specially formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do NOT use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.

## PART 3 - EXECUTION

### 3.01 EXAMINATION AND PREPARATION OF SURFACES TO RECEIVE WORK OF THIS SECTION

A. Prior to the installation the materials of this Section, the tile/stone subcontractor shall inspect surfaces to receive feather edge floor patch material, membrane waterproofing, ceramic tile and natural stone elements.

B. Surfaces to receive the materials of this Section shall be structurally sound and free of dirt, dust, oil, curing compounds and other contaminants. The tile/stone subcontractor shall notify The Architect and Contractor in writing of any serious defects or condition that will interfere with a satisfactory installation, and he shall not proceed with the installation until such defects or conditions have been corrected. Starting installation work in a room or space shall indicate acceptance of conditions.

C. Maximum permissible variation in floor surfaces which receive thin-set tile shall be 1/8" in 10'-0".
1. The floor slab shall comply with written instructions of the manufacturer of sheet membrane waterproofing.

D. Maximum permissible variation in wall surfaces which receive thin-set tile shall be 1/8" in 8'0".

3.02 STONE FABRICATION - GENERAL

A. Fabricate stone per specifications, Drawings, and shop drawings.

B. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.

C. Grade and mark stone for final locations to produce assembled countertops with an overall uniform appearance.

D. Fabricate stone countertops in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.
   1. Clean sawn backs of stones to remove rust stains and iron particles.
   2. Dress joints straight sand at right angle to face, unless otherwise indicated.
   3. Cut and drill sinkages and holes in stone for anchors, supports, and attachments.
   4. Provide openings, reveals, and similar features as needed to accommodate adjacent work.
   5. Fabricate molded edges with machines having abrasive shaping wheels made to reverse contour of edge profile to produce uniform shape throughout entire length of edge and with precisely formed arris slightly eased to prevent snipping, and matched at joints between units. Form corners of mounded edges as indicated with outside corners slightly eased.
   6. Finish exposed faces of stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

3.03 INSTALLATION - GENERAL

A. Install materials of this Section (and other related Sections) under the Quality Control provisions of Section 01405 and in accordance with TCA Handbook methods, as hereinafter listed.

3.04 INSTALLATION OF FEATHER EDGE CEMENT PATCHING MATERIAL

A. Mix and install feather edge cement patching material, over structural concrete slabs, in accordance with the manufacturer's recommendations.
   1. Preparation -
      a. Concrete surfaces shall be structurally sound and free of dirt, dust, oil, curing compounds and other contaminants, and then vacuum clean.
   2. Application -
      a. Use flat side of steel trowel to apply the patching materials, approximately 3/8" thick at perimeter of rooms and at flat areas near doorways, and sloping to a feather edge thickness at floor drains. See marble threshold detail for maximum thickness as door.

3.05 INSTALLATION OF MEMBRANE WATERPROOFING
(typical at all ceramic tile floors, and at "exterior" walls of restrooms)

A. Membrane shall be installed in strict accordance with Latecrete's current written procedures for waterproofing. Use the most current Tile Council of

America's recommendation and ANSI standards for the type of tile, stone and bonding agent in this particular application. Verify suitability with each manufacturer.

1. Membrane waterproofing shall be adhered to featheredge patching that has been cleaned and free of dust, dirt and debris.
2. Sheet waterproofing shall extend over floor drain flange and shall be clamped to drain body, similar to TCA Method B415-12.
3. Sheet waterproofing shall extend to face of perimeter walls of rooms scheduled to receive ceramic floor tile and turn up walls 3".
4. At "exterior" walls of all restrooms, extend waterproofing full height to above ceiling. Wrap around 12" onto interior walls, and marry into floor waterproofing.

B. Comply with manufacturer of bonding agents' (latex-Portland cement mortar) recommended procedures for hot or cold weather.

C. If membrane is not covered by wearing surface immediately, provide protection from all pedestrian or vehicular traffic and UV light.

D. Test for waterproof application.
1. Upon completion of work, plug the floor drains and fill with water. Inspect for leakage. Make necessary adjustments to stop all leakage and retest until watertight.

3.06 INSTALLATION OF CEMENT BACKER BOARD

A. Verify that 20-ga. studs are spaced a maximum of 12" o.c.

B. Install cement backer board in accordance with manufacturer's printed instructions.
1. Shim board so face is flush with adjoining gypsum wallboard and to provide space for the turned-up sheet membrane waterproofing to extend up behind the cement backer board. At inside corners there will be folds in the waterproofing "pan" that will result in 3 layers of sheet membrane waterproofing.
2. Attach board to shims and framing with screws spaces 8" on center at walls. Pre-drill holes in cement board to screws.
3. All joints in cement board shall be taped and filled as required by the cement board manufacturer.

3.07 INSTALLATION OF CERAMIC/PORCELAIN TILE, STONE ELEMENTS, AND MARBLE THRESHOLDS

A. Install ceramic and porcelain tile floors and base, ceramic tile walls, and marble thresholds in accordance with ANSI A108.5, using thin-set latex Portland cement mortar.

B. Install ceramic tile floors and base, stone elements, and marble thresholds in accordance with Tile Council of America, Inc., Handbook for Ceramic Tile Installation, 2017 Edition; as follows:
1. Floors on concrete slabs with membrane waterproofing: Method F122-17.
2. Base and walls on masonry substrates: Method W202-17.
3. Base and walls on plaster substrates: Method W223-17.
4. Expansion Joints: Method EJ171-17.
   a. Provide expansion joints at perimeter of (ceramic/porcelain) tile flooring where tile abuts ceramic/porcelain base.
   b. Provide expansion (control) joints in ceramic tile flooring where

shown on Drawings.
c. Provide silicone sealant at expansion joints as specified in Section 07900.

5. Tile on cement backer board with membrane: Method B412-17.

C. Lay ceramic tile to pattern specified. Lay porcelain tile in "stacked bond". Verify pattern is uninterrupted through openings.

D. Hold cuts to a minimum with no cut pieces smaller than 1/2 tile size unless absolutely necessary. Make cuts on outer edges of field. Smooth cut edges. Install ceramic tile and stone without jagged or flaked edges.

E. Cut and fit ceramic tile and stone tight to protrusions and vertical interruptions. Cut ceramic tile and stone with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges.

F. Align ceramic tile and stone joints to produce uniform grout lines. Joints shall be watertight, without voids, cracks, excess mortar or grout.

G. Sound ceramic tile and stone elements after setting. Replace hollow sounding units.

H. Allow ceramic tile and stone elements to set for a minimum of 48 hours prior to grouting.

3.09 INSTALLATION OF STONE COUNTERTOPS

A. Clean stone elements by thoroughly scrubbing with fiber brushes and then drenching with clear water. Clean with mild cleaning compounds that contain no caustic or harsh materials or abrasives. Allow stone to dry before installing.

B. Construction tolerances:
1. For vertical lines and surfaces, do not exceed 1/16” in 48”.
2. Variation from level: do not exceed 1/8” in 96”, ¼” maximum.
3. Variation in joint width: do not vary width more than ¼ of the 1/16” specified joint.
4. Variation in plane at joints (lipping): do not exceed 1/64” difference between planes of adjacent units.
5. Variation in line of edges at joints (lipping): do not exceed 1/64” difference between edges of adjacent units, where edge line continues across joint.

C. Installation:
1. Install countertops over plywood subtops with full spread of water-cleanable epoxy adhesive.
2. Do not cut stone in field. If stone countertops or splashes require additional fabrication to be performed at site, return to fabrication shop for adjustment.
3. Set stone to comply with requirements shown on Drawings and approved shop drawings. Shim and adjust stone to location shown. Install countertops with uniform joints of widths shown and with edges and faces aligned.
4. Bond joints with stone adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

5. Space joints with 1/16” gap for filling with sealant. Use temporary shims to ensure uniform spacing.
6. Install backsplash and endsplashes by adhering to wall with water-cleanable epoxy adhesive. Leave 1/16” gap between countertop and splashes for filling with sealant.
7. Apply sealant to joints, removing temporary shims prior to applying sealant.

3.11 CLEANING

A. Clean ceramic tile and natural stone elements in accordance with the requirements of Section 01710.

B. All cleaning shall be in accordance with the tile and stone manufacturer's printed instructions.

3.12 PROTECTION

A. Close to traffic all spaces in which ceramic tile or stone elements are being set and other tile or stone work is being done. Keep closed until tile or stone is firmly set. Before, during and after grouting, keep area clean, dry and free from foreign materials and air flow which will interfere with setting and curing of grout.

B. Newly completed floors shall not be walked on nor worked on without using boards or equivalent protection of the Work.

END OF SECTION

SECTION 09 51 00 - ACOUSTICAL CEILINGS

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Furnish and install acoustical ceilings where indicated on the Drawings and as specified herein to include:
   1. 24" x 48" lay-in acoustical panels supported by exposed grid suspension system.

B. Furnish and install acoustical insulation above lay-in ceilings where shown on Drawings.

### 1.02 WORK NOT INCLUDED

A. Unless otherwise indicated, the exposed portions of acoustical ceiling components are factory finished; therefore, field painting will not be required.

### 1.03 SUBMITTALS

A. Submit samples of all acoustical panels and tiles for Architect's review and approval.

B. Submit manufacturer's product data, including storage, handling, and installation instructions.

C. Submit manufacturer's recommended maintenance and cleaning instructions.

### 1.04 ENVIRONMENTAL CONDITIONS

A. Installation of acoustical treatment shall not begin until all wet work is completely dry.

B. Materials shall be installed under standard occupancy conditions from 60° to 85° F, and not more than 70% relative humidity, in an enclosed building with the mechanical HVAC equipment in operation.

### 1.05 COORDINATION

A. Contractor shall verify all measurements and dimensions at the jobsite and he shall coordinate and schedule his work with the work of other trades affected by his installation, with particular attention given to Mechanical and Electrical Trades.

B. Ceiling subcontractor shall carefully coordinate ceiling grid installation with headboxes for Motorized Window Shade Systems, Section 12494. A pre-installation conference shall be scheduled before grid is set in rooms to receive such single and dual roller window shades.

### 1.06 REFERENCED STANDARDS

A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory.

B. Fire-Test-Response Characteristics:
   1. Fire-Resistance Characteristics: Where indicated, provide acoustical tile ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
      a. Identify materials with appropriate markings of applicable testing and inspecting agency.
   2. Surface-Burning Characteristics: Acoustical tiles complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.
      a. Smoke-Developed Index: 450 or less.

C. Seismic Standard: Comply with the following:
   1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
   2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."

D. Comply with the following, as applicable:
   1. ASTM C635, "Standard Specifications for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile & Lay-In Panel Ceilings".
   2. ASTM C636, "Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile & Lay-In Panels".
   3. ASTM E84 (UL-723), Surface Burning Characteristics of Building Materials (Fire-Hazard Test).

## PART 2 - PRODUCTS

### 2.01 ACOUSTICAL TILE CEILINGS, GENERAL

A. Acoustical Tile Standard: Comply with ASTM E 1264.

B. Metal Suspension System Standard: Comply with ASTM C 635.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, “Direct Hung,” unless otherwise indicated. Comply with seismic design requirements.
   1. Anchors in Concrete: Expansion anchors fabricated from corrosion-resistant materials, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
   1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.

E. Seismic struts and seismic clips.

F. Metal Edge Moldings and Trim: Edge molding to be hemmed shadow molding with prefinished exposed flanges, #7873, nominal size 9/16”x15/16”x3/8” reveal.

2.02 ACOUSTICAL PANELS

A. Panels shall be UL-rated "Cirrus" beveled tegular tile, product of Armstrong, 24" x 48" x 3/4" thick, Item No. 539, at all 24" x 48" grid.

2.03 SUSPENSION SYSTEM FOR ACOUSTICAL PANELS (LAY-IN)

A. Suspension system components shall be as follows:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated below:
      a. Armstrong World Industries, Inc.; 9/16” Suprafine XL, in a 24" x 48" grid.
         1) Color: White
   2. Direct Hung Suspension System: Intermediate duty structural classification.

2.04 SUSPENSION SYSTEM DESIGN

A. All suspension systems shall be designed, furnished and installed in accordance with methods recommended by the Acoustical Materials Association. Members of sufficient size and strength shall be used to limit the simple span total load deflection to span/360. Load tabulations shall include items which are furnished by other trades, but which are supported by the suspension system: i.e., light fixtures, diffusers, access panels, etc. All allowable load carrying capacity of members shall be been determined by the manufacturer as a result of physical load tests conducted in accordance with methods and procedures recommended by AMA.

B. Modify systems components as required when Drawings indicate miscellaneous areas where grid pattern is other than the panel sizes specified.

PART 3 - EXECUTION

3.01 CEILING INSTALLATION

A. Acoustical materials and suspension systems shall be installed in accordance with applicable requirements of ASTM C636 and CISCA’s “Ceiling Systems Handbook”.

B. Install wall moulding at intersection of suspended ceiling and all vertical surfaces. At moulding corners, provide corner cap trim. At sloping ceilings modify wall angles as required so that lower flange will be parallel with the ceiling.

C. Provide hold-down clips at all cut tiles around perimeter.

D. After light fixtures have been placed, install additional wire hanger at each corner of grid in which fixture is located if it is recessed and 4' on center along fixture line if they are surface mounted.

E. After air distribution system is completed, add wire hanger at each corner of grid in which diffusers occur.

F. Where reveal-edge tile must be cut, shape cut edge to match standard factory edges and paint white to match ceiling tile face.

G. Level the entire grid after all weight is in place, except acoustical material, and tie off all hangers securely.

H. Carefully set continuous cove trim true-to-line, anchoring with manufacturer’s attachment clips.

I. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders.

J. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires
   1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
   2. Do not attach hangers to steel deck tabs or to steel roof deck.

K. Install edge mouldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical tiles. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.

L. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

3.02 CLEANING

A. After installation, all exposed surfaces of acoustical panels and tiles shall be thoroughly cleaned of any dirt, grease, finger marks or other imperfections, with materials recommended by the manufacturer. Any damaged units shall be replaced at no cost to the Owner.

3.03 EXTRA STOCK

A. Supply an extra 2% of each acoustical panel and tile used for Owner's future use. Acoustical panels and tiles shall be stored in clean, marked boxes.

END OF SECTION

SECTION 09 65 00 - RESILIENT FLOORING

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Furnish and install resilient tile flooring, rubber base and related accessories in areas where indicated on the Drawings and specified herein.

### 1.02 SUBMITTALS

A. Submit samples for Architect's selection.

B. Submit product data, including fire test results and recommended adhesives for floor tile and rubber base.

C. Submit maintenance data, including recommended cleaning agents and waxes.

### 1.03 PROJECT/SITE CONDITIONS

A. Environmental Requirements:
   1. Store materials at not less than 70 degrees F. for at least 72 hours before installation.
   2. Do not install materials if inside temperature is below 70 degrees F.

## PART 2 - PRODUCTS

### 2.01 VINYL COMPOSITION TILE

A. VCT Type #1: Tile shall be 12" x 12" x 1/8" thick, Class 2 – through pattern, product of Mannington Commercial, or approved equal.
   1. Tile color to be selected by Architect from "Solidpoint" Collection.

### 2.02 RUBBER BASE

A. Rubber cove base shapes in 1/8" thickness, 6" heights typical and 120' lengths shall be equal to "Wallflowers", product of Marley Flexco Company, Marley Floors Inc, Tuscumbia, AL (800-633-3151).

B. Inside corners shall be mitered. Outside corners shall be pre-formed. Height of preformed corners shall precisely match height of rubber base.

C. Color to be selected by Architect from manufacturer's standard colors.

### 2.03 TILE REDUCER STRIP NO.1 (Resilient tile to concrete)

A. Equal to #192A Tile Reducer Strip (1/8" x 1"), as manufactured by Marley Flexco Company, Marley Floors Inc, Tuscumbia, AL (800-633-3151).

B. Color to be selected by Architect from manufacturer's standard colors.

### 2.04 TILE REDUCER STRIP NO. 1 (Carpet to concrete)

A. Equal to Johnsonite #CTA-XX-P, throat opening to match carpet thickness.

B. Color to be selected by Architect from manufacturer's standard colors.

2.05 ADHESIVES

A. Adhesives used for the installation of floor tile and rubber base shall be a product of the same manufacturer as the flooring or base with which they are used.

B. Adhesive for vinyl composition floor tile shall be as recommended by Armstrong.

C. Adhesives for rubber base shall be compatible with the various wall materials/finishes and shall be as recommended by Flexco.

2.06 FIRE TEST REQUIREMENTS

A. All resilient flooring shall comply with the following Fire Test requirements:
   1. Flame Spread of 25 or less for the Tunnel Test when tested in accordance with ASTM E-84.
   2. Smoke obscuration of 450 or less when measured in the NBS Smoke Density Chamber and in accordance with ASTM E-662.
   3. Critical Radiant Flux of 0.45 watts/cm for the Flooring Radiant Panel Test and in accordance with ASTM E-648.

## PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect surfaces scheduled to receive resilient flooring and base for acceptability.

B. Verify all surfaces as clean and free from moisture, paint, oil, grease and wax.

C. Caution: Verify dryness of concrete slabs to receive resilient flooring, in accord with Resilient Flooring Institute Recommendations, prior to beginning floor tile installation.

3.02 PREPARATION

A. Patch cracks, holes, depressions, and other imperfections in surfaces which are scheduled to receive resilient flooring with a latex or epoxy floor patch material especially manufactured for this purpose. At locations where partitions are removed from fields of asbestos tile to remain, or at locations where asbestos tile is abated from only a portion of a room, use floor patch to level slab up to plane of asbestos tile to remain. Floor patch material shall be compatible with the floor covering, shall be unaffected by moisture and/or floor cleaning chemicals, and shall be workable to a feather-edge thickness. Floor patch material shall be trowel applied and checked to a line with an 8' straight edge. Maximum allowable tolerance shall be 3/16" in 8' in any direction. Floor patch materials after curing shall be machine sanded to provide a smooth, plane surface.

B. All wall surfaces, to be covered with rubber base, shall be smooth and solid. All voids, cracks and joints shall be filled solid at wall areas to be covered with rubber base.

3.03 INSTALLATION

A. Tile joints shall be aligned in both directions. "Grain" of tile shall all run in the same direction within one room or space. Lay tiles square with room axis.

B. Tile to be laid typically in single-color pattern. Simple blocks of color change may be required at such locations as entrances, corridor transitions, etc. Match banding patterns in existing adjacent VCT flooring to remain.

C. Cut tile to and around all permanent fixtures. Remove excess adhesive from surface of tile.

D. No tile work shall be started until work of other trades, including painting, has been substantially completed.

E. Temperature shall be maintained at not less than 70 degrees F. during and 72 hours immediately before and after installation.

F. Install beveled edging material 1/8" thick x 1" wide as specified where tile terminates against rooms or spaces which are not scheduled to receive flooring (center below door).

G. Flooring shall be laid out so that tiles less than half-size generally will not be required.

H. Provide rubber base at wood cabinets, unless otherwise noted.

I. Flooring shall be rolled as per manufacturer's printed instructions.

J. Rubber base must follow the contour of the wall. Where walls change plane, a prefabricated base corner piece shall be cut to return to the secondary wall plane. At wall reveals that extend to the floor, cut prefabricated corners so that base can turn into reveal.

K. Rubber base must always return to a hard surface (for example, at frames that do not extend to the wall face, return base back to frame with prefabricated corner pieces).

L. Where rubber base abuts shaped wood base, cope rubber neatly to shape of wood base.

3.04 CLEANING AND WAXING

A. When tile flooring has been sufficiently seated, clean in accordance with manufacturer's directions. Apply two coats of wax in accordance with manufacturer's maintenance recommendations and polish with mechanical buffer.

3.05 EXTRA STOCK

A. Supply an extra 2% of each resilient flooring pattern used, including floor tile and rubber base. Extra stock shall be supplied in clean, marked cartons for Owner's use.

END OF SECTION

SECTION 09 68 00 – CARPET

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Provide carpet floor covering in spaces so scheduled on the Drawings.

B. The carpet sub-contractor shall furnish and install carpeting, including related accessories.

### 1.02 SUBMITTALS

A. Samples: 24” x 24” duplicate pieces of each type, color, pattern.

B. Manufacturer's literature: Specifications, installation instructions, and maintenance instructions with manual.

C. Fiber requirements: Certification that specified fiber is used.

D. Certificate of compliance: certification that carpet meets all Performance listed below.

E. Test report: UL Fire Hazard Classification.

### 1.03 QUALITY ASSURANCE

A. Single Source Responsibility: Provide products from a single manufacturer.

B. Manufacturer: Company specializing in manufacturing commercial carpet with 5 years minimum documented experience.

C. Installer Qualifications: Installer shall be a firm established not less than 5 years and, if requested, shall submit evidence of having furnished and installed commercial carpet projects of similar size and scope for at least 5 years. Carpet installer shall be mill-certified by carpet manufacturer.

### 1.04 PREINSTALLATION MEETING

A. Convene one week minimum prior to commencing work of this Section.

B. Attendance shall be required of manufacturer, installer, general contractor, and architect.

### 1.05 PRODUCT DELIVERY, STORAGE, HANDLING, AND ENVIRONMENTAL REQUIREMENTS

A. Deliver carpet to job site in wrapped rolls. Deliver adhesive in original unopened containers legibly labeled or tagged.

B. Handle carpet in manner to prevent bending of roll or damage to wrapping.

C. Store in enclosed building where temperature and humidity are stabilized to levels of occupancy.

D. Maintain ambient temperature and humidity conditions during and after installation of carpet at levels indicated during occupancy.

E. Allow carpet to reach room temperature or minimum temperature recommended by manufacturer before beginning installation.

F. Protect adhesives from freezing.

1.06 WARRANTY

A. Manufacturer:
   1. Lifetime Limited Modular Warranty
   2. Lifetime Limited Duracolor Stain Warranty
   3. Lifetime Static

B. Installer: All workmanship and installation shall be guaranteed for a period of one (1) year from Final Project Acceptance.

## PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Basis of Design (Carpet Types 1, 2, and 3) shall be the products specified below by The Mohawk Group, 500 TownPark Lane, #400, Kennesaw, GA 30144, 800-554-6637. Equal products will be considered.

2.02 CARPET

A. Carpet Type 1 (10th and 11th Floors): Equal to "Owls Collection"
   1. Construction: tufted
   2. Surface Texture: textured patterned multi-colored loop
   3. Dye system: solution dyed.
   4. Gauge: 1/112" (47 rows per 10cm)
   5. Stain Release Technology: Permanent, Built into the Fiber
   6. Fiber Type: Duracolor® Tricor Nylon.
   7. GSA Stain Release Rating: Passes
   8. Color: "Flight / 829 Great Horned"
   9. Backing Materials: EcoFlex® NXT
   10. Indoor Air Quality: Green Label Plus Certified #1171
   11. Installation method: Random
   12. Static Propensity: AATCC – 134 Under 3.5 KV
   13. Flammability: ASTM E 648 Class I (Glue Down)
   14. Smoke Density: ASTM E 662 – Less than 450.
   15. Size: 12" x 36".

B. Carpet Type 2 (Garden Room 1201): Equal to "Fortitude III" in color 142, "Courage" to be made into four (4) rugs, 8' x 40', utilizing binding color 754, "Khaki".

C. Carpet Type 3 (Ballroom 1200): Equal to "Fortitude III" in color 738, "Virtue".
   1. Product Type: woven
   2. Construction: woven
   3. Minimum Sq. Yd.: No minimum
   4. Surface Texture: Textured Heathered Loop
   5. Pitch: 216 (315 ends per meter)

6. Woven Pile Weight: 33.5 oz. per sq. yd. (1136 g.m²)
7. Finished Pile Thickness: .143” (3.63mm)
8. Rows per inch: 7.0 (27.56 per 10cm)
9. Dye Method: Solution Dyed
10. Fiber Type: Duracolor® Premium Nylon
11. Fiber Technology: Duracolor® my Mohawk Group’s Stain Resistant System. Passes GSA requirements for permanent stain resistant carpet.
12. Stain Release Technology: Permanent, Built into Fiber
13. Soil Release Technology: EcoSentry Soil Protection
14. Density: 8,434
15. Weight Density: 282,539
16. Backing Material: Woven
17. Width: 12’ width (3.66m)
18. Pattern Repeat: 0.50” (W) x 0.38” (L)
19. Flammability: ASTM E 648 Class 1 (Glue Down)
20. Smoke Density: ASTM E 662 Less than 450
21. Static Propensity: AATCC-134 Under 3.5 KV
22. Foot Traffic Recommendation TARR: Heavy
23. GSA Stain Release Rating: Pass

2.03 RELATED PRODUCTS

A. Adhesives: Low VOC type as recommended by carpet manufacturer.

B. Leveling compound: Latex type as recommended by carpet manufacturer.

C. Subfloor Leveler System: Equal to "Johnsonite Leveler Strip", LS Series, 12" wide, of thickness required to assure smooth transition to differing thicknesses of carpet.

D. Vinyl carpet transition strips:
1. Transition Strip No. 1, carpet-to-vinyl tile: Equal to #67 Tile and Carpet Joiner by Marley Flexco, throat openings to match carpet thickness and tile thickness.

## PART 3 - EXECUTION

3.01 INSPECTION OF SURFACES TO RECEIVE CARPETS

A. Inspect all substrates which shall be in a smooth level plane, free from any imperfections and free from dirt and dust. Notify the Contractor, in writing, if any condition exists that would be detrimental to proper installation of the carpet, including slab moisture from construction water infiltration (General Contractor shall be responsible for drying such slabs). Fill and level all cracks, holes, and floor irregularities and depressions to ensure a smooth, finished appearance, and to prevent accelerated wear, including all such floor prep in Bid, to attain floor levelness within 1/8" in 10'. The application of any carpeting shall be an indication of the carpet sub-contractor's acceptance of the sub-surface conditions and he shall be held responsible for any defects after laying the carpet.

3.02 MEASUREMENTS

A. Carpet subcontractor shall verify all dimensions for carpeting at building site before ordering and cutting carpet.

B. Submit proposed seam diagram to Architect prior to commencing work.

3.03 INSTALLATION

A. Recommended installation procedure of manufacturer of carpet shall be followed exactly.

B. Prime concrete floor only if extremely porous or has excessive dust. Any existing sealer or primer should be tested for compatibility with the carpet manufacturer's approved adhesive.

C. All carpet tiles should be rolled with a 75 lb. or 100 lb. roller.

D. Cutting border tiles: Make cuts from the back. Install border tiles by placing the tile face down exactly on top of the last row of field tiles, keeping the arrows pointed in the same directions. This will be the cut tile. Using another tile, butt it against the wall allowing it to lie on top of the tile that is to be cut. Using this tile as a reference tile, score a line on the back of the tile that is to be cut. Cut the tile along the reference line being careful not to cut through the installed tile below. Install the cut tile with the cut edge along the wall. Use this same technique at doorways and other objects that must be cut around. A transition strip must be used to protect any exposed edges.

E. Remove all rubbish and wrapping paper from job site.

F. All usable excess pieces of carpet shall be left with the Owner for future repairs, beyond the warranty period, by the Owner.

G. Lay out carpet to obtain minimum number of seams.

H. Cut to length required, scribing neatly and tightly around projections, recesses, penetrations, etc.

I. Cement seams and all cut edges, matching pattern at seams.

J. Apply adhesives uniformly in accordance with manufacturer's recommendations. Cover only that area that can be covered by carpet within the working time of the adhesive. Do not use more than the recommended amount of adhesive. Do not allow adhesive on the face of the carpet.

K. Install carpet carefully to fit abutting surfaces closely. Broom or roll to remove wrinkles and air pockets. Do not install over hardened adhesive.

L. Assure smooth transition from one carpet height to a different carpet height using the Johnsonite (or equal) subfloor leveling system, in the appropriate thickness.

3.04 CLEANING AND PROTECTION

A. Protect adjacent surfaces from adhesive and other damage.

B. Clean spilled, excessive or misplaced adhesive from surfaces immediately, using recommended solvent where necessary.

C. Vacuum with commercial beater bar type cleaner.

D. To avoid damage to carpet, schedule floor installations to begin only after all structural work, building enclosure, and overhead finished work, such as ceilings, painting, mechanical, and electrical work, are completed. Keep all traffic off carpet until Final Acceptance. Provide protection to floors after installation.

3.05 EXTRA STOCK

A. Provide to the Owner forty (40) pieces of each color utilized for Carpet, from same dye lot as used for the job, boxed in protective covering and tagged.

END OF SECTION

SECTION 09 84 00 – ACOUSTICAL WALL TREATMENT

## PART 1 - GENERAL

### 1.01 SUMMARY

A. Scope: furnish and install custom fabricated acoustical wall panels.

### 1.02 REFERENCES

A. ASTM C423 Standard Test Method for Sound Absorption and Sound Coefficients by the Reverberation Room Method.

B. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

C. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

### 1.03 SUBMITTALS

A. Product Data: Submit product data sheet for specified products.

B. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.

C. Samples: Submit selection and verification samples of finishes, colors and textures.

D. Test Reports: Certified test reports showing compliance with specified performance requirements.
   1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of retesting.

### 1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

B. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at the required temperature and humidity levels as recommended by the manufacturer.

### 1.05 PROJECT CONDITIONS

A. Environmental Requirements: Do no install panels until wet work, such as concrete, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60-80 degrees F and 35% minimum RH and 55% Maximum RH, respectively. All products constructed with wood or wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualification: Manufacturer shall have a minimum of 5 years' experience in production of specified products and shall furnish supporting documentation showing completed jobs of approximately the same size and scope.

B. Fire Test Reports: Provide acoustical wall panels with the following surface-burning characteristics as per ASTM E84.
   1. Flame Spread: 25 or less.
   2. Smoke Developed: 450 or less.

C. Acoustical Test Report: provide acoustical test report from a qualified testing agency indicating wall panels meets 1.15 NRC per ASTM-423.

PART 2 - PRODUCTS

2.01 ACOUSTICAL WALL PANELS

A. Manufacturer: Products shall be equal to those manufactured by Acoustical Solutions, Inc., 2420 Grenoble Road, Richmond, VA 23294. Telephone: (800) 782-5742.

B. Manufactured Units: "AlphaSorb™ Wall Panels" or equal.
   1. Panel Thickness: Nominal 2" thick
   2. Panel Weight: 6.0 – 7.0 lb. per cubic foot high-density fine fibered fiberglass.
   3. Panel Size: As indicated on Drawings.
   4. Facing Material: 100% polyester fabric, FR 701 Style 2100 by Guilford of Maine.
      a. Color: As selected from fabric manufacturer's full range of colors (58 standard colors).
   5. Noise Reduction Coefficient: NRC 1.15.

C. Construction: The acoustical wall panel product shall be supplied in widths up to 4 feet wide and lengths up to 10 feet long. All edges will be fully wrapped with mounting as indicated.

D. Mounting: Z-Clips: Two part metal clips from the manufacturer designed to support weight of panel. One part mechanically attached to wall substrate according to manufacturer's standard pattern and other part fastened to back of panel.

E. Acoustical Performance:
   a. Sound Absorption: Per ASTM-423
   b. Sound Absorption Coefficient per Octave Band Center Frequency (Hz)

| 125 | 250 | 500 | 1000 | 2000 | 4000 | NRC |
|---|---|---|---|---|---|---|
| 0.22 | 0.81 | 1.24 | 1.30 | 1.21 | 1.16 | 1.15 |

PART 3 - EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for

product installation in accordance with manufacturer's instructions. Do not install panels until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install acoustical wall panels in locations indicated on Drawings, top edges level and in alignment with other panels. Comply with manufacturer's written instructions for installation of panels using type of mounting accessories indicated.

3.03 CLEANING

A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as-new condition.

END OF SECTION

SECTION 09 91 00 - PAINTING

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Furnish labor, materials, equipment and supervision necessary to complete the painting and finishing work required by the Drawings and specified hereinafter, including, but not necessarily limited to, view-exposed or weather exposed portions of:
   1. Interior drywall and plaster, which shall receive a finish similar to existing plaster.
   2. Interior standing and running wood trim.
   3. Interior hollow metal doors and frames, and miscellaneous metals.
   4. Miscellaneous other items and surfaces, as noted or required to finish new or patched work.

B. Prime coats will not be required on items delivered with prime or shop coats applied as specified under other Sections, for the following:
   1. Structural and miscellaneous steel and iron.

C. The following items shall receive shop finishing or shall be finished by other sections:
   1. Stain-grade wood doors shall be factory finished at Sections 08 14 00 and 08 14 33.

D. Unless otherwise indicated, field painting is not required for items of copper, brass, bronze, aluminum, stainless steel, chromium and aluminized steel.

E. Exterior brick will not be painted.

F. Related work specified elsewhere:
   1. Section 07 90 00 - Sealants and Caulking.
   2. Section 06 01 20 - Finish Carpentry & Millwork.
   3. Section 08 14 00 - Wood Doors.
   4. Section 08 14 33 - Stile and Rail Wood Doors.
   5. Section 09 21 00 - Lath and Plaster.

### 1.02 DELIVERY AND STORAGE OF MATERIALS

A. Deliver specified products in original containers with labels intact on each container. All paint materials shall be kept in a locked area assigned to the painting sub-contractor. Use of other parts of the buildings for storage and/or mixing of paint materials is prohibited. Follow all applicable regulations and precautions to prevent fire.

### 1.03 SUBMITTALS

A. Submit manufacturer's full and complete color charts, for all materials specified, to Architect for color selection. Field samples of paints and finishes shall be prepared by the Contractor, as required by Architect.

B. Architect will furnish the Contractor with a schedule of paint colors and finishes, keyed to the surfaces to which they are to be applied.

1.04 FIELD SAMPLES

A. Provide a 8' x 8' (or equivalent 100 s.f. area) field sample of each specified system on each type of surface to be coated, to verify that the preparation and finish are acceptable.
   1. This sample is required for every color and gloss level selected.

B. Accepted samples may remain as part of the work.

1.05 WARRANTIES

A. The installer shall warrant that paints and coating will not crack, check, peel, or allow exterior water to penetrate the coating for a period of five (5) years. Any coating failing the above criteria shall be re-prepped, primed, and painted at no cost to Owner. Warranty to include all exterior wood and steel surfaces.

B. The manufacturer shall provide the installer with a five (5) year material replacement warranty covering the items described in the paragraph above.

1.06 PROJECT/SITE CONDITIONS

A. Environmental Conditions:
   1. Do not apply paint and finishes when the temperature of surfaces to be coated, including ambient temperatures, are below 50°F for exterior work and 60°F for interior work. Maximum temperature shall be 110°F.
   2. Exterior painting shall be thoroughly dry. Interior painting shall not be done until the building is thoroughly dried out by either natural or artificial heat. All surfaces shall be thoroughly dry and a minumum of 5°F above the dew point.
   3. The general contractor and the painting contractor shall also thoroughly familiarize themselves with the lead-based paint findings at "Appendix B". Though limited lead-based paint was detected, the general contractor and/or the painting contractor is expected to make all cost provisions, in his bid, for compliance with OSHA regulations for working with removal or abrasion of any paint, whether lead-based or not, and shall make provisions for protecting the building's occupants during such operations. See report for additional compliance information.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Paint Products: Materials itemized in the "Schedule of Paints and Finishes" shall be equal to products of Benjamin Moore & Company and other manufacturers as specified. No materials are to be reduced or intermixed, except as directed on the label. In spite of any substitutions that may be approved, all colors shall be selected from color palette of Benjamin Moore, and painter shall be responsible for cross-matching selected colors to custom colors by other manufacturers.

## PART 3 - EXECUTION

### 3.01 GENERAL

A. Materials are to be prepared, stored and applied in strict accordance with manufacturer's printed instructions.

B. Paints, stains and other finishes shall be evenly spread and flowed on, and shall be free from runs, sags, brush marks and other defects. All coats shall be thoroughly dry before applying succeeding coats. Exterior oil paints shall be allowed to dry at least 48 hours between coats; interior oil paints, at least 24 hours between coats.

C. Finishes on woodwork shall be sanded between coats with fine sandpaper or steel wool to produce an even, smooth finish.

D. All primers and undercoats of this Section shall be tinted to approximately the color of the finish coat.

E. Interior painting shall not be done until the building is thoroughly dried out by either natural or artificial heat.

F. Protect adjacent work and materials with suitable covers and drop cloths during the process on the work.

G. All surfaces to be painted shall be clean and free of loose paint, dirt, dust or grit before finishing is started. Clean metal surfaces with naphtha or benzene before painting.

H. If the prime coat applied does not dry to a uniform sheen on the entire surface, spot prime the areas that indicate suction before applying finish coats.

I. Clean off all misplaced paint so as to leave the work in a clean and finished condition. Oily rags and waste must be removed from the building and site at the end of each work day.

J. Before painting or finishing, remove hardware, fixtures, accessories, plates, and other similar items. Upon completion of each space, replace the above items.

K. Prior to commencement of any painting and finishing work, adjacent portions of the building, including floors, shall be vacuumed clean of construction debris and dust.

L. Cut-in paint neatly around glass and other edges.

M. At completion of painting and finishing work, remove from the premises all surplus painting materials and all debris. Remove all spattering and leave the work of this Section in a clean and finished condition.

N. After the specified number of coats of paint and paint products have been applied, if visual inspection indicates non-uniform and/or incomplete coverage, then an additional coat (or coats) shall be applied until uniform and complete coverage is achieved.

O. Fill nail holes, cracks, and seams in woodwork with putty. Apply putty after prime coat is dry.

P. All materials shall be applied in accordance with manufacturer's printed instructions. Dry paint shall be not less than 4 mils thickness on the exterior and 3 mils thickness on the interior. The painting shall be by roller or brush application, except that aliphatic and epoxy coatings shall be applied by spray. The texture of roller for desired finish shall be approved by the Architect.

3.02 PROTECTION

A. Remove all oily rags and waste from the building and site at the end of each work day. Take every precaution to avoid danger of fire.

3.03 PREPARATION OF EXISTING SURFACES

A. Existing painted wood:
   1. Interior:
      a. Existing interior wood base, chair rail, picture mould and crown mould shall be salvaged and restored to its original condition of sharp corners and detail. Where such detail has been obscured by multiple layers of paint, chemically strip such trim to expose original level of detail, prime, and paint.
      b. Square edged trim may be prepared as follows if condition allows:
         1.) Remove oil, wax or grease with mineral spirits or xylol.
         2.) Knots, resins, gum pockets or extractives shall be sealed with a mixture of equal parts shellac and alcohol.
         3.) Remove mildew by scrubbing with a solution of one tablespoon of dry powdered laundry detergent and one quart Clorox mixed in three quarts of warm water. After scrubbing, rinse thoroughly with clean water.
         4.) Remove excessive chalking or dirt by washing with water. Hard glossy surfaces shall be sanded or dulled with liquid surface conditioner.
         5.) Removal of loose blistering, crazing, or alligatoring paint: When existing paint blemishes, continuous patterns of deep cracks, extensive blistering and peeling to the base wood cannot be corrected with superficial cleaning or sanding, paint shall be removed, using the gentlest means possible, down to the next sound layer of paint or to the original wood substrate. At conditions of paint failure, painter shall verify soundness of wood substrate prior to proceeding with application of finish paint coats.
            a.) Peeling: Damaged paint can be scraped off with putty knife or hand or mechanically-sanded.
            b.) Cracking/Alligatoring: If cracking or alligatoring is occurring in only the top layer(s), damaged paint may be scraped or hand or mechanically-sanded to the next sound layer, then repainted. If these conditions have progressed to bare wood and the paint has begun to flake, the paint must be totally removed by means such as scraping, electric heat plate, electric heat gun, or application of chemical strippers, depending on the particular area involved. Bare wood should be primed within 48 hours and the repainted.

c.) Approved methods of paint removal for historic restoration work: Scrapers, putty knives, sand paper, sanding block, sanding sponge, orbital sander, belt sander (in limited conditions), electronic heat plate, electronic heat gun, and chemical strippers (to be used with extreme caution).

d.) Methods of removal not allowed for historic restoration work: rotary sanders, high pressure waterblasting in excess of 600 p.s.i., sandblasting, blowtorching.

6.) Existing paint which is to remain shall have edges sanded to a feather edge so as to blend into adjacent unpainted areas. After feather edge sanding, all wood surfaces shall be primed as specified for painting of new wood.

7.) Sand existing painted surfaces as required to produce a smooth surface suitable to receive new paint.

8.) When existing coating exhibits failure over 25% or more of the surface, complete removal of the existing coating shall be performed. The surface shall then be treated as specified for new wood.

9.) Brush or dust surfaces as required to remove dust particles.

c. After existing paint has been treated, or removed as described above, repair wood trim with automotive body filler to restore crisp edges and detail. Fill all blemishes and damage with body filler and sand smooth. Re-cut miters where required to assure a tight fit. Set nails, fill holes with body filler, sand, prime, and paint.

C. Existing plaster finishes to remain:
1. Scrape all loose, scaling paint.
2. Featheredge sand all paint sound enough to remain.
3. Prime all pitted, cracked, or missing plaster areas to be patched with #023 Undercoater with 10% Penetrol as specified.
4. Patch plaster as required – see 09210.
5. Reprime entire wall with #023 Undercoater.
6. Apply finish coats.

3.05 SCHEDULE OF PAINTS AND FINISHES

A. Interior Wood - "Opaque" (Painted) Finish :
1. Moore's Fresh Start Acrylic Primer #023
2. Moorcraft Ultra Spec Acrylic Semi-Gloss Enamel #N539
3. Moorcraft Ultra Spec Acrylic Semi-Gloss Enamel #N539.

B. Interior New Plaster Walls or New Plaster Patches - Low Sheen Finish:
(At repaired or new plaster walls)
1. Moore's Fresh Start Acrylic Primer #023
2. Moorcraft Ultra Spec Acrylic Low Sheen #N537
3. Moorcraft Ultra Spec Acrylic Low Sheen #N537.

C. Gypsum Board - Low Sheen Finish:
(Typical finish for walls, furring, ceilings)
(Low Sheen or eggshell finish to be selected upon completion of job samples)
1. Moore's Fresh Start Acrylic Primer #023
2. Moorcraft Ultra Spec Acrylic Low Sheen #N537
3. Moorcraft Ultra Spec Acrylic Low Sheen #N537.

D. Gypsum Board – Eggshell Finish:
(Typical finish for walls, furring, ceilings)
(Low Sheen or eggshell finish to be selected upon completion of job samples)
1. Moore's Fresh Start Acrylic Primer #023
2. Moorcraft Ultra Spec Acrylic Low Sheen #N538
3. Moorcraft Ultra Spec Acrylic Low Sheen #N538.

E. Interior Gypsum Board Walls – Semi-Gloss Epoxy Finish:
1. Moore's Fresh Start Acrylic Primer #023.
2. Moore's Super Spec Acrylic Epoxy Semi-Gloss #256
3. Moore's Super Spec Acrylic Epoxy Semi-Gloss #256.

F. Interior Ferrous Metals:
(Hollow metal frames, doors, etc.)
See Paragraph 3.01P hereinbefore for preparation and field prime coat requirements at hollow metal doors and frames.
1. Moore's I.M.C. Alkyd Metal Primer (M06)
2. Moorcraft Super Spec Alkyd Semi-Gloss Enamel (C271)
3. Moorcraft Super Spec Alkyd Semi-Gloss Enamel (C271).

END OF SECTION

SECTION 10 14 00 – IDENTIFYING DEVICES

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and other Division 1 Specifications sections, apply to this Section.

### 1.02 DESCRIPTION OF WORK

A. The work required under this section consists of identifying devices including:
   1. Cast Plaque Signs
   2. Photopolymer Face Signs

### 1.03 REFERENCES

A. Conform to the standards, specifications, codes, laws, and references listed hereinafter.

B. ADA – Americans with Disabilities Act.

C. ANSI A117.1 – Accessible and Usable Buildings and Facilities.

### 1.04 SUBMITTALS

A. Product Data: Submit product data for specified products. Include material details for each sign specified.

B. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including dimensions, anchorage, and accessories.

C. Samples: Submit supplier’s standard color chart for selection purposes and selected colors for verification purposes.

D. Installation: Submit supplier’s installation instructions.

E. Closeout Submittals:
   1. Submit operation and maintenance data for installed products, including precautions against harmful cleaning materials and methods.
   2. Submit warranty documents specified herein.

### 1.05 QUALITY ASSURANCE

A. Supplier: Obtain all products in this section from a single supplier.

### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Store products protected from weather, temperature, and other harmful conditions as recommended by supplier.

D. Handle products in accordance with manufacturer's instructions.

1.07 WARRANTY

A. Manufacturer's Warranty: Submit manufacturer's standard warranty document executed by authorized company official.
   1. Warranty Period: One year from project Final Acceptance.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Cast Bronze Plaque Signs shall be equal to products of Gemini Incorporated 103 Mensing Way Cannon Falls, MN 55009 PH: (800) 421-1256. Website: www.signletters.com

B. Photopolymer Face Signs shall be equal to products of ASI Modulex, 1101 24th Street Kenner LA 70062. (504)704-1000, (504)704-1006 fax.

2.02 MATERIALS

A. Cast Bronze Plaque Signs:
   1. Base Cast bronze, in .125” thickness.
   2. Base Cast bronze, in .25” thickness.

B. Photopolymer Face Signs:
   1. Face: ASI Intouch Photopolymer Face, in matte (non-glare) finish.
   2. Backing Plate: Acrylic.
   3. Installation (for wall mounting): System MH, mounting holes for fasteners in backing plate so they will be concealed behind face.
   3. Installation (for glass mounting): System SA, silicone adhesive. On opposite side of glass, provide self-adhering vinyl sheet cut exact dimensions of sign, and adhered to glass to conceal back of sign. Vinyl color shall be selected by Architect.

2.03 FABRICATION OPTIONS

A. Cast Bronze Plaque Signs:
   1. Tactile Graphics and Text:
      a. Fabrication process: Provide tactile copy and grade 2 Braille raised 1/32” minimum from plaque first surface.
      b. Provide lettering and graphics precisely formed, uniformly opaque to comply with relevant ADA regulations and requirements indicated for size, style, spacing, content, position, and colors.
   2. Border: Inset Single Line Border, .25” wide.
   3. Background Color: Dark Oxide
   4. Background Texture: Smooth
   5. Clear Coat Finish: Matte
   6. Raised text and graphic finishes: “Light Oxidized (+15%)” Bronze Finish.
   7. Letter style: Arial, (uppercase)

B. Photopolymer Face Signs
   1. Tactile Graphics and Text:
      a. Fabrication process: Provide tactile copy and grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer's photopolymer bonded process. Sign face of single material, tactile characters and Braille integral to photopolymer. Adhesive-fixed characters are not acceptable.
      b. Provide lettering and graphics precisely formed, uniformly opaque to comply with relevant ADA regulations and requirements I ndicated for size, style, spacing, content, position, and colors. Tactile characters to be raised min. 1/32" from surface. Computerized translation of sign copy to be responsibility of the manufacturer.
   2. Mounting Panel Options:
      a. Size: Same Size.
      b. Thickness: .125 inch thick matte finished acrylic.
   3. Background Appearance Options:
      a. Solid colors: To be selected by Architect from manufacturer's standard range.
   4. Tactile Lettering and Graphics Color Options: To be selected by Architect from manufacturer's standard colors.
   5. Overall panel size: See Signage Schedule.
   6. Shape: Standard.
   7. Letter style, colors, letter sizes and layout position: See Signage Schedule.
   8. Text schedule: All letters to be capitalized.
   9. Options: Updateable Window Insert

2.04 FABRICATION – GENERAL (Photopolymer Face Signs)

A. General: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

B. Preassemble signs in the shop to the greatest extent possible to minimize field assembly. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view final assembly.

C. Conceal fasteners if possible; otherwise, locate fasteners to appear inconspicuous.

D. Form panels to required size and shape. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.

E. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.

2.04 INSTALLATION METHOD

A. Install as per manufacturer's recommendations for given substrates and conditions.

B. Install at locations and heights as described in Sign Schedule.

2.05 FABRICATION – GENERAL

A. General: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

B. Preassemble signs in the shop to the greatest extent possible to minimize field assembly. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view final assembly.

C. Conceal fasteners if possible; otherwise, locate fasteners to appear inconspicuous.

D. Form panels to required size and shape. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.

E. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.

## PART 3 - EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions: Verify installation conditions previously established under other sections are acceptable for product installation in accordance with manufacturer's instructions.

B. Scheduling of installation by Owner or its representative implies that substrate and conditions are prepared and ready for product installation. Proceeding with installation implies installer’s acceptance of substrate and conditions.

3.02 INSTALLATION

A. Install product in accordance with supplier’s instructions.

B. Install product in locations indicated using mounting methods recommended by sign manufacturer and free from distortion, warp, or defect adversely affecting appearance.

C. Install product level, plumb, and at heights indicated.

D. Install product at heights to conform to Americans with Disabilities Act Accessibility Guidelines (ADAAG) and applicable local amendments and regulations.

E. Install signs within the following tolerances and in accordance with manufacturer's recommendations:
   1. Interior Signs: Within 1/4 inch vertically and horizontally of intended location.

3.03 CLEANING, PROTECTION, AND REPAIR

A. Repair scratches and other damage which might have occurred during installation. Replace components where repairs were made but are still visible to the unaided eye from a distance of 5 feet.

B. Remove temporary coverings and protection to adjacent work areas. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project in accordance with provisions in Division 1.

3.04 SIGN SCHEDULE

A. Schedule: Refer to signage schedule/elevations for sizes, locations, and layout of signage types, sign text copy, and graphics.

END OF SECTION

Sign Schedule
10th and 11th Floors DMH Tenant Improvements

| Room No. Plan Reference | Room No. As It Appears On Sign | Room Description As It Appears On Sign | Door Location | Sign Type | Comments |
|---|---|---|---|---|---|
| TENTH | FLOOR | | | | |
| 1000 | 1000 | | 01 | 2 | EDITABLE TEXT WINDOW |
| 1001 | 1001 | | 02 | 2 | EDITABLE TEXT WINDOW |
| 1004 | 1002 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1003 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1005 | 1004 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1006 | 1006 | | 04 | 2 | EDITABLE TEXT WINDOW |
| 1007 | 1007 | | 05 | 2 | EDITABLE TEXT WINDOW |
| 1008 | 1008 | | 06 | 2 | EDITABLE TEXT WINDOW |
| 1009 | 1009 | | 07 | 2 | EDITABLE TEXT WINDOW |
| 1010 | 1010 | | 08 | 2 | EDITABLE TEXT WINDOW |
| 1012 | 1012 | STORAGE | 09 | 1 | |
| | | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1013 | 1011 | PRIVATE | 10 | 3 | |
| 1014 | 1005 | PRIVATE | 11 | 3 | |
| 1003 | | ELECTRICAL | | 3 | |
| 1015 | | JANITOR | 12 | 3 | |
| 1017 | | MEN | 13 | 5 | |
| 1018 | | WOMEN | 14 | 4 | |
| 1019 | | MECHANICAL | 15 | 3 | |
| 1020 | 1013 | | 16 | | GLASS FILM PATTERN TO MATCH 9TH FLOOR |
| 1021 | 1014 | BREAK ROOM | 18 | 1 | |
| 1023 | 1015 | STORAGE | 17 | 1 | |
| 1024 | 1016 | PRIVATE | 20 | 3 | |
| | 1017 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1025 | 1018 | STORAGE | 21 | 1 | |
| 1026 | 1019 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1020 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1021 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1022 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1023 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1027 | 1024 | | 22 | 2 | EDITABLE TEXT WINDOW |
| | 1025 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1026 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1027 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1028 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |

Sign Schedule
10th and 11th Floors DMH Tenant Improvements

| Room No. Plan Reference | Room No. As It Appears On Sign | Room Description As It Appears On Sign | Door Location | Sign Type | Comments |
|---|---|---|---|---|---|
| 1030 | 1029 | STORAGE | 23 | 1 | |
| 1031 | 1030 | | 24 | 2 | EDITABLE TEXT WINDOW |
| 1032 | 1031 | | 25 | 2 | EDITABLE TEXT WINDOW |
| 1033 | 1032 | | 26 | 2 | EDITABLE TEXT WINDOW |
| 1034 | 1033 | | 27 | 2 | EDITABLE TEXT WINDOW |
| 1035 | 1034 | | 28 | 2 | EDITABLE TEXT WINDOW |
| | | | | | |
| ELEVENTH | FLOOR | | | | |
| 1100 | 1100 | | 29 | 2 | EDITABLE TEXT WINDOW |
| 1101 | 1101 | | 32 | 2 | EDITABLE TEXT WINDOW |
| 1103 | 1102 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1104 | 1103 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1110 | 1104 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1105 | 1105 | | 34 | 2 | EDITABLE TEXT WINDOW |
| 1106 | 1106 | | 35 | 2 | EDITABLE TEXT WINDOW |
| 1107 | 1107 | | 36 | 2 | EDITABLE TEXT WINDOW |
| 1108 | 1108 | | 37 | 2 | EDITABLE TEXT WINDOW |
| 1109 | 1109 | | 38 | 2 | EDITABLE TEXT WINDOW |
| 1111 | 1110 | STORAGE | 33 | 1 | |
| | 1111 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1112 | 1112 | PRIVATE | 39 | 3 | |
| 1135 | 1116 | | 30 | | EDITABLE TEXT WINDOW |
| | 1115 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1114 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1102 | 1113 | PRIVATE | 40 | 3 | |
| 1134 | | ELECTRICAL | | 3 | |
| 1113 | | JANITOR | 41 | 3 | |
| 1114 | | MEN | 42 | 5 | |
| 1115 | | WOMEN | 43 | 4 | |
| 1117 | | MECHANICAL | 44 | 3 | |
| 1118 | 1117 | | 45 | | GLASS FILM PATTERN TO MATCH 9TH FLOOR |
| 1119 | 1120 | BREAK ROOM | 46 | 1 | |
| 1121 | 1119 | STORAGE | 47 | 1 | |
| 1122 | 1118 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1124 | 1121 | PRIVATE | 49 | 3 | |
| 1123 | 1122 | STORAGE | 50 | 1 | |

Sign Schedule
10th and 11th Floors DMH Tenant Improvements

| Room No. Plan Reference | Room No. As It Appears On Sign | Room Description As It Appears On Sign | Door Location | Sign Type | Comments |
|---|---|---|---|---|---|
| | 1123 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1124 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1125 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1126 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1127 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1125 | 1128 | | 51 | 2 | EDITABLE TEXT WINDOW |
| | 1129 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1130 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1131 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| | 1132 | | | 2 | EDITABLE TEXT WINDOW - (CUBICLE) |
| 1128 | 1133 | STORAGE | 52 | 1 | |
| 1129 | 1134 | | 53 | 2 | EDITABLE TEXT WINDOW |
| 1130 | 1135 | | 54 | 2 | EDITABLE TEXT WINDOW |
| 1131 | 1136 | | 55 | 2 | EDITABLE TEXT WINDOW |
| 1132 | 1137 | | 56 | 2 | EDITABLE TEXT WINDOW |
| 1133 | 1138 | | 57 | 2 | EDITABLE TEXT WINDOW |

SECTION 10 21 13 – STAINLESS STEEL TOILET COMPARTMENTS

## PART 1 - GENERAL

### 1.01 SUMMARY

A. Section includes:
   1. Provide new stainless steel toilet compartment partitions, floor mounted, overhead-braced, where shown on Drawings.

### 1.02 REFERENCES

A. ASTM International (ASTM):
   1. ASTM A 240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   2. ASTM A 666 – Standard Specification for Annealed for Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   3. ASTM A 743/A 743M – Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
   4. ASTM B 86 – Standard Specification for Zinc and Zinc Aluminum (ZA) Alloy Foundry and Die Castings.
   5. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
   6. ASTM B 221/B 221M – Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings.

B. International Code Council (ICC)/American National Standards Institute (ANSI):
   1. ICC/ANSI A117.1 – Accessible and Usable Buildings and Facilities, as applicable to toilet compartments designated as accessible.

C. United States Department of Justice:
   1. ADA – Americans with Disabilities Act, Excerpt from 28 CFR Part 36 – ADA Standards for Accessible Design.

### 1.03 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets for each type of product indicated. Include fabrication details, description of materials and finishes.
   1. Product Test Reports: When requested by Architect, submit documentation by qualified independent testing agency indicating compliance of products with requirements.

B. Shop Drawings: Include overall product dimensions, floor plan, elevations, sections, details, and attachments to other work. Include choice of options with details.

C. Samples for Selection: Furnish samples of manufacturer's full range of finishes for initial selection.

D. Samples for Verification: Furnish physical samples of material in selected finish.
   1. Size: 8" x 8" minimum, in type of finish specified.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Approved manufacturer with minimum five (5) years experience in the manufacture of toilet compartments.

B. Installer Qualifications: Experience installer regularly engaged in installation of toilet compartments for minimum of three (3) years.

C. Source Limitations: Obtain toilet compartment components and accessories from single manufacturer.

D. Accessibility Requirements: Comply with requirements of ICC/ANSI 117.1, and with requirements of authorities having jurisdiction.

E. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 0
   2. Smoke-Developed Index: 0

1.07 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver toilet compartments to site until building is enclosed and HVAC systems are in operation.
   1. Deliver toilet compartments in manufacturer's original packaging.
   2. Store in an upright condition.

1.08 WARRANTY

A. Special Manufacturer's Warranty: Provide manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship during the following period after substantial completion.
   1. Stainless Toilet Partitions: Against rust-out: 15 years.
   2. Stainless Steel Hardware: Lifetime.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Compartments and accessories shall be equal to products of Bradley Corporation, Mills Metals Division, Menomonee Falls, WI 53051 (800-272-3539).

2.02 MATERIALS

A. Stainless Steel Sheet: A 666, 300 series commercial stainless steel sheet suitable for exposed applications. Provide smooth material, without creases or ripples.
   1. Provide with No. 4 finish.

B. Stainless steel Castings: ASTM A 743/A 743M.

C. Zinc Aluminum Magnesium and Copper Alloy (Zamac): ASTM B 86.

D. Aluminum: ASTM B 221/ B 221M.

2.03 STAINLESS STEEL TOILET COMPARTMENTS

A. Toilet Compartment Type:
   1. Floor anchored, overhead braced.
      a. Basis of design product: Bradley, Mills Partitions, Floor-mounted, overhead-braced, Series 400-Sentinel.

B. Door, Panel, and Pilaster Construction, General: Form edges with interlock to provide watertight fit without crown molding. Braze corners and finish smooth.
   1. Provide exposed surfaces free of pitting, visible seams and fabrication marks, stains, telegraphing of core material, or other imperfections.
   2. Core Material: solid particleboard core.
   3. Corners: all welded.

C. Door Construction: 1 inch thick, constructed from 0.0313 inch/22 ga stainless steel.
   1. Provide each door with internal 0.0625 inch/16 ga and 0.0781 inch/14 ga welded reinforcements at top and bottom hinge locations, with factory installed concealed true gravity cam hinges.
   2. Provide pre-punched hole to permit field installation of ADA-compliant concealed slide latch.
   3. Core material: solid particleboard core.

D. Panel Construction: 1 inch thick, constructed from 0.0313 inch/22 ga stainless steel.
   1. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
   2. Tapping Reinforcement: Provide concealed reinforcement for drilling and tapping holes at locations where machine screws are used for attaching items to units.
   3. Core material: solid particleboard core.

E. Pilaster Construction: 1-1/4 inch thick, construction from 0.0375 inch/20 gauge stainless steel.
   1. Provide pilaster with internally welded reinforcement suitable to accept minimum 8 inch long, 3/8 inch zinc-plated jack bolt for leveling. Connect bracket to two L-brackets secured to floor to allow for full range of adjustment.
   2. Core material: solid particleboard core.

F. Headrail: Extruded stainless headrail with anti-grip profile. Provide clamps for attachment to pilaster and stainless steel brackets to secure to wall. Headrails shall be secured to tops of pilasters and headrail brackets by thru-bolting with one-way stainless steel sex bolts. At the end of a bank of toilet compartments with freestanding end condition, headrail shall return to plumbing wall for anchorage; provide neat metal closure for corner condition. Within each bank of toilet compartments, return headrail back to wall above the dividing partition of the handicap stall. See other locations on Drawings. Headrail brackets shall be 14 gauge extruded aluminum.

G. Shoes: 4 inches high minimum, Type 304 stainless steel with No. 4 satin brushed finish. Provide concealed retainer clips to attach to pilaster.

H. Brackets (Fittings):
   1. Full-height (Continuous) Type: 12-ga (minimum) stainless steel U-brackets, single-ear, or double-ear, brackets.

2.04 HARDWARE

A. Hardware, Standard Duty: All stainless steel, including all fasteners, to be tamper-resistant:
   1. Hinges: Self-closing, continuous spring-loaded type, adjustable to hold doors open at any angle up to 90 degrees, with emergency access by lifting door.
   2. Latch and Keeper: Concealed turn knob latch, flat, rubber-faced combination door strike and keeper, with provision for emergency access, meeting requirements for accessibility at accessible compartments.
   3. Coat Hook: Combination hook and rubber-tipped stop, sized to prevent door from hitting compartment-mounted accessories. Provide wall bumper where door abuts wall. Provide formed L-shaped hook without stop at outswing doors.
   4. Door Pull: Standard unit on outside of inswing doors. Provide pulls on both sides of outswing doors.

2.05 FABRICATION

A. Overhead-braced units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Door size and swings: Unless otherwise indicated, provide 26 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

3.01 EXAMINATION

A. Examine work area to verify that measurements, substrates, supports, and environmental conditions are in accordance with manufacturer's requirements to allow installation.
   1. Proceed with installation once conditions meet manufacturer's requirements.

3.02 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.

B. Install toilet partitions and screen in spaces with operating, temperature controlled HVAC systems. Shield partitions and screens from direct sunlight.

C. Clearances: Install with clearances indicated on Drawings. Where clearances are not indicated, allow maximum ½ between pilasters and panels, and 1 inch between panels and walls.

D. Continuous Brackets: Secure panels to walls and to pilasters with continuous brackets attached with five (5) fasteners to panel and to wall. Locate wall brackets to holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.

3.03 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 15 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

3.04 FINAL CLEANING

A. Remove packaging and construction debris and legally dispose of off-site.

B. Clean partition and screen surfaces with materials and cleansers in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 10 28 13 - TOILET ACCESSORIES

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Furnish and install the toilet accessories as specified herein.

### 1.02 SUBMITTALS

A. Furnish shop drawings and product data sheets to Architect for approval.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Products listed below shall be equal to those of Bobrick, or other manufacturers as may be specified.

### 2.02 PRODUCTS

A. Electric Hand Dryer:
   1. Aircraft Recessed Hand Dryer, #B-750 115-Volt, baked enamel finish.
   2. Qty: (4) total.

B. Bathroom Hook:
   1. Heavy-Duty Clothes Hook, #B-211, satin nickel-plated finish.
   2. Qty: One each at all toilet partition doors.

C. Toilet Tissue Dispenser:
   1. Equal to Liberty Hardware Manufacturing Corporation, “Century” Twin Toilet Paper Holder, satin stainless steel finish.
   2. Qty: One (1) each at all water closets.

D. Grab Bar #1:
   1. B-6806 Series, 36" length, 1-1/2" outside diameter, 18 gauge stainless steel, non-slip (peened) finish.
   2. Secure to metal stud walls (concealed solid wood blocking) with concealed anchors. Secure to masonry walls with metal expansion anchors and concealed fasteners.
   3. Qty: (4) total.

E. Grab Bar #2:
   1. B-6806 Series, 42" length, 1-1/2" outside diameter, 18 gauge stainless steel, non-slip peened finish.
   2. Secure to metal stud walls (concealed solid wood blocking) with concealed anchors. Secure to masonry walls with metal expansion anchors and concealed fasteners.
   3. Qty: (4) total.

F. Sanitary Napkin Disposal #1:
   1. Catalog #B-4354, partition-mounted dual napkin disposal, type 304 stainless steel, with all welded construction and polished to a satin finish. Removable leak-proof 0.7 gal. plastic receptacle.

2. Cabinet shall be 12-3/4" wide x 11" tall, thru-mounted to toilet partition.
3. Qty: (2) total.

G. Mop Hook Strip:
1. Catalog #B-223, 24" length, 20-gauge stainless steel and polished to a satin finish.
2. Mop hook strip shall have three (3) spring-loaded hard rubber cam holders, hanging mops 3-1/4" from wall.
3. Surface mount to wall with exposed screws and metal expansion anchors.
4. Qty: (2) total.

H. Anchors and Fasteners: As recommended by the product manufacturer for securing to the various wall and partition materials.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. Grab bars shall be mounted with centerline 33" above floor at the "handicapped" toilets.

B. Grab bar installation shall comply with requirements of ANSI A117.1-1998, Section 609.8, relative to structural strength.
1. This requirement states: "Allowable stresses in bending, shear, and tension shall not be exceeded for materials used where a vertical or horizontal force of 250 pounds is applied at any point on the grab bar, fastener mounting device, or supporting structure."

C. Secure toilet accessories with anchors and fasteners as recommended by the accessory manufacturers, and at a minimum, as follows:
1. Masonry walls –
Use all metal expansion anchors (plastic anchors not acceptable).
2. Hollow stud partitions –
Secure to solid wood backing (as provided by other trades) with concealed wood screws.
3. Toilet compartments –
Use fasteners recommended by the toilet compartment manufacturer.

D. Anchors and fasteners shall be as recommended by the product manufacturer.

E. All toilet accessories shall be mounted per most current edition of Americans with Disabilities Act. Contractor shall verify mounting heights of any accessories not dimensioned on Drawings with Architect.

END OF SECTION

SECTION 11 31 00 - APPLIANCES

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Provide, set, and connect commercial kitchen appliances as specified below.

### 1.02 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and other Division1 specification sections, apply to this section.

### 1.03 DESCRIPTION OF WORK

A. The work required under this section consists of supplying and installing appliances and related items to complete the work as indicated in the Contract Documents.

### 1.04 WORK INCLUDED IN OTHER SECTIONS

A. The following Sections relate to work in this Section:
   1. Division 22 - Mechanical
   2. Division 26 - Electrical

### 1.05 PRODUCT DELIVERY AND STORAGE

A. Do not deliver items specified in this section to the job site until the time for installation. Protect materials from weather and damage during transit and job site delivery.

### 1.06 SUBMITTALS

A. Submit product information for each type of appliance listed.

## PART 2 - PRODUCTS

### 2.01 MICROWAVE (2 Required)

A. Products equal to "KitchenAid 2 CU. FT. Countertop Microwave Oven" (#KMCS1016GSS) as manufactured by KitchenAid. Electric Rating: 120V, 60 Hz, 20A.

### 2.02 REFRIGERATOR (2 Required)

A. Products equal to “Summit 24” wide Built-In All-Refrigerator, ADA Compliant” model #AL54 as manufactured by Summit.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. Install in accordance with Manufacturer's written instructions and in accordance with the Contract Documents, making final connections.

### 3.02 WARRANTY

A. Provide Manufacturer's written warranty for items specified.

END OF SECTION

SECTION 12 21 13.23 – WOOD HORIZONTAL LOUVER BLINDS

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Furnish and install horizontal wood slat louver blinds and operating hardware for all exterior window openings designated at 3.06 below.

B. The blinds shall be installed by a company approved by the manufacturer, with installers qualified to install the specified product as demonstrated by previous experience.

### 1.02 SUBMITTALS

A. Complete shop drawings, indicating field-measured dimensions of openings to receive blinds, tolerances required, components, details on mounting surface and sill conditions, details of corners and conditions between adjacent blinds, and method of attachment and support.

B. Product literature, indicating physical characteristics of components, finishes, and operating features.

C. Colors: Submit manufacturer’s full range of available slat and housing colors for Architect’s selection.

D. Samples: Submit two samples 6” long illustrating materials, finish and color of slats, and cord.

### 1.03 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section.

B. Manufacturer’s certificate: Certify that products meet or exceed specified requirements.

C. Fabricator: Company specializing in fabrication and assembly of blinds, approved by manufacturer.

### 1.04 DELIVERY, STORAGE AND HANDLING

A. Material shall be delivered in original unopened packages, fully identified as to manufacturer, brand or other identifying data.

B. Material shall be stored (above ground), under cover and in a dry location until ready for use.

### 1.06 WARRANTY

A. Provide manufacturer’s standard five-year warranty. The manufacturer shall repair or replace during the term of the warranty, without charge, any part found defective in workmanship or material as long as the blind remains in its original window opening.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. The Specification herein is based on the product of Levolor, Greensboro, North Carolina, or equal as manufactured by Springs Window Fashions, Ft. Mill, SC, or Hunter Douglas, Upper Saddle River, NJ.

### 2.02 MATERIALS

A. Acceptable product Custom 2" Wood Blind manufactured by Levolor.
   1. Headrail shall be of 0.025" thick steel, "U" shaped, 1-1/2" high x 2-1/4" wide with flanged edges at top, and coated with baked on finish. All hardware shall be enclosed in the metal headrail.
   2. Tilt wand shall be of polymer with a 0.38" diameter, color coordinating with the slats of the blind.
   3. Cord lock shall be of 0.032" thick steel and shall be securely attached to headrail. It shall be a crashproof type with sufficient sensitivity to lock slats at desired height upon release of cords, or by swinging cords toward jamb while lowering slats. A revolving serrated cam shall gently sub all cords to hold the raised slats level at the desired height, increasing its grip for heavier loads.
   4. Drum and cradle shall be provided for each ladder.
      a. Drums are injection molded thermo plastic or 0.020 galvanized steel. Drum, in combination with cradles shall provide smooth, noise free operation when blind is tilted.
      b. Cradles shall be of injection molded thermoplastic. They shall provide bearing support for the tilt rod, thus preventing the weight of the blind from being transferred to the tilter. Cradles shall center drums over ladder openings.
   5. Tilt rod shall be a D-shaped Tomized steel rod with an average cross section of 0.28" designed to achieve minimum torsional deflection.
   6. End braces shall be of 0.030" thick Tomized steel with reinforcing ribs positively fastened to both ends of headrail. End braces shall incorporate a field adjustable tab to ensure secure installation, center blind in window, and prevent lateral movement.
   7. Installation brackets shall be of at least 0.040" thick Tomized steel with finish to match headrail. The brackets shall incorporate a rivet-hinged safety locking front cover to permit removal of headrail without lateral movement. Mounting holes shall be located to accommodate overhead, side, or face mounting.
   8. Intermediate brackets shall be installed with blinds over 55 sq. ft. Brackets shall be U-shaped, 0.044" Tomized steel, with retainer fingers and mounting holes for overhead or face mounting. They shall be evenly spaces at maximum 72" apart. Brackets shall be supplied as required.
   9. Ladders (slat supports) shall be braided polyester yarn dyed to Levolor color standard. The two vertical components shall be 0.080" x 0.063" designed for maximum flexibility combined with minimum stretch and tensile strength of not less than 70 lbs. per cable. Horizontal components (rungs) shall consist of not less than four cables inter-braided with the vertical components. Ladder shall support the slats without visible distortion. Distance between slats shall not exceed 44 mm (nominally 6.9 slats per vertical foot). Distance between ladders shall not exceed 24" for blinds up to 80" long. For blinds

over 80" long, distance between ladders shall not be greater than 28". Distance between end ladder and end of slat shall not exceed 7".

10. Slats shall be of premium quality hardwood finished with a solid coating selected from Levolor Custom colors, sealed, and lacquered. Maximum slat length is 96" to avoid material deflection. Standard 2" slats are nominally 2" wide. Slat thickness is nominally 1/8". Slats shall perform to 500 hours of 100% relative humidity testing, 300 hours of 5% salt spray solution at 95 degree F testing, and 250 hours of accelerated weathering testing without blistering, fading, corroding, or adhesive failure. Slat thickness and ladder support distances shall prevent visible sag or bow after continued use indoors.
11. Bottom rail shall be of solid wood, nominally 2" wide x 5/8" high and finished to coordinate with slats. Bottomrail shall have protective ladder caps designed to prevent bottom bar from marring window sill and/or mullions.
12. Lift cord shall be braided of high strength, 1.8 mm diameter polyester fiber (1.4 mm for LightMaster) with a high tenacity polyester core, 26 picks per inch, 16 carrier smooth braids, and shall be flexible, have minimum stretch, maximum abrasion resistance characteristics, and a minimum breaking strength of 175 lbs. Cord shall be of sufficient length equalized to properly control raising and lowering of blind and spaced not over 42" between cords.
13. Options shall include:
    a. Fabric Tapes: Woven cotton twill tapes shall be 1-1/2" wide and dyed to Levolor color standard. Fabric rungs shall be permanently sewn to vertical components. Distance between tape centers shall not exceed 36". Distance between center of end tape to end of slat shall not exceed 7", unless otherwise specified for special job condition. Distance between slats shall not exceed 44 mm (nominally 6.9 slats per vertical foot).
    b. LightMaster privacy feature – privacy. Slats can be removed for cleaning. Cord will be 1.4 mm in diameter and will be run up both sides of ladder to provide full support. Distance between ladders shall not exceed 36". Distance between center of end tape to end of slat shall not exceed 7", unless otherwise specified for special job condition.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

A. Visually determine that project is ready to receive the work of this Section; beginning work indicates acceptance of conditions. All interior wet work shall be complete prior to installation of this product, including plaster, sheetrock, taping, floating (and sanding); and ceilings, electrical, and mechanical work above the product shall be complete.

### 3.02 INSTALLATION

A. Install work in strict accordance with manufacturer's printed instructions and as supplemented herein. Secure in place with concealed fasteners.

B. Custom fit blinds to each window sash, and where more than one window occurs per opening (connected with mullion), provide a separate blind for

each window, aligning break with centerline of mullion. Fabricate blinds to fit between window jambs.

3.03 TOLERANCES

A. Maximum Variation of Gap at Window Opening shall be 1/4” each end.

B. Maximum offset from level shall be 1/8”.

3.04 ADJUSTING

A. Adjust all moving parts for smooth operation.

3.05 CLEANING

A. Clean as recommended by manufacturer, and ensure proper drying by providing adequate ventilation.

3.06 INSTALLATION LOCATION SCHEDULE

A. Install blinds at exterior windows on the 10th and 11th floors, (except for restroom windows) as noted on drawings.

END OF SECTION

SECTION 12 24 13 – ROLLER WINDOW SHADES

## PART 1 - GENERAL

### 1.01 DESCRIPTION

A. Scope: Provide labor, materials, equipment and supervision required to provide manually operated, roll-up fabric interior window shades at exterior windows as indicated on the Drawings and as herein specified.

### 1.02 RELATED SECTIONS

A. Section 06100 – Rough Carpentry: Wood blocking and grounds for mounting roller shades and accessories.

### 1.03 REFERENCES

A. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. NFPA 701-99 - Fire Tests for Flame-Resistant Textiles and Films.

### 1.04 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Installation and Maintenance instructions.
   3. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
   4. Storage and handling requirements and recommendations.
   5. Mounting details and installation methods.

B. Shop Drawings: Submit manufacturer's shop drawings showing plans, elevations, sections, product details, installation details, operational clearances, and relationship to adjacent work.
   1. Prepare shop drawings on Autocad format using base sheets provided electronically by the Architect.

C. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.

D. Selection Samples: For each finish product specified, one set of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shade fabric sample and aluminum finish sample as selected. Mark face of material to indicate interior faces.

F. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

G. Manufacturer Certificates: Certify products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years' experience in manufacturing products comparable to those specified in this section.

B. Installer Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years' experience in installing products comparable to those specified in this section.

C. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

D. Mock-Up: Provide a mock-up of one of each type roller shade assembly specified for evaluation of mounting, appearance and accessories.
   1. Locate mock-up in window(s) designated by Architect.
   2. Do not proceed with remaining work until mock-up is accepted by Architect.

E. Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.

B. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.

C. Label containers and shades according to Window Shade Schedule.

D. Store products in manufacturer's unopened packaging until ready for installation.

1.07 PROJECT CONDITIONS

A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress

1.08 PROJECT CONDITIONS

A. Install roller shades after finish work and ambient temperature, humidity and ventilation conditions are maintained at levels recommended for project upon completion.

1.09 WARRANTY

A. Roller Shade Hardware and Shade Fabric: Manufacturer's standard non-depreciating twenty-five-year limited warranty.

B. Roller Shade Installation: One year from date of Final Acceptance, not including scaffolding, lifts or other means to reach inaccessible areas.

## PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Basis of Design Manufacturer: Draper, Inc., 411 S. Pearl, P. O. Box 425; Spiceland, IN 47385-0425; ph 800-238-7999; email: drapercontract@draperinc.com; Web: www.draperinc.com

2.02 APPLICATION/SCOPE

A. Roller Shade Schedule:
Manually operated, roll-up fabric interior window shades including mounting and operating hardware at exterior windows in the following rooms: Ballroom 1200, Garden Room 1201 and NE Conference room 1202.

2.03 MANUALLY OPERATED WINDOW SHADES

A. Manually Operated Window Shades with Independent Control: Manually operated, vertical roll-up, fabric window shade with components necessary for complete installation; Clutch-operated FlexShade as manufactured by Draper, Inc.
   1. Operation: Bead chain and clutch operating mechanism allowing shade to stop when chain is released. Designed never to need adjustment or lubrication. Provide limit stops to prevent shade from being raised or lowered too far.
      a. Clutch mechanism: Fabricated from high carbon steel and molded fiberglass reinforced polyester or injected molded nylon. Minimum 20 lb. lifting capacity. White or Black color as selected by Architect.
      b. Bead chain loop: Stainless steel bead chain hanging at side of window.
      c. Idler Assembly: Provide roller idler assembly of molded nylon with adjustable or spring-loaded length idler pin to facilitate easy installation, and removal of shade for service.
      d. Bead Chain Hold Down: P-Clip (standard).
   2. Single Roller Configuration:
      a. Mounting:
         1) Endcaps and fascia.
      b. Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall, and jamb. Provide size compatible with roller size.
         1) Endcap covers: To match fascia or headbox color.
      c. Fascia: L shaped aluminum extrusion to conceal shade roller and hardware.
         1) Attachment: Snaps into endcaps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands. No notching is required.

2) Shape: Square Fascia Panel.

3. Roller Tube: Fabricated from extruded aluminum, galvanized steel, or enameled steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade type and size. Minimum roller diameter 1.5 inches. Fabric connected to the roller tube with LSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.
4. Shade slat:
   a. Closed pocket elliptical slat: 1 inch (25 mm) aluminum elliptical slat inside of a 1-5/8 inch (41 mm) pocket with heat sealed ends.

2.04 FABRIC

A. Light-Filtering Fabric
   1. Basis-of-Design: SheerWeave® Series SW2000, as manufactured by Phifer.
   a. Fabric Content and Structure: 63 percent PVC-coated fiberglass and 37 percent fiberglass yarns, 500 denier, woven into a 2 x 2 non-directional basketweave with Microban® Protection.
   b. Performance Characteristics:
      1) Flame retardant per NFPA 101 (Class A), NFPA 701 (TM#1, small scale), NFPA 701 (TM#2, large scale), California U.S. Title 19, BS 5867-2 (Type B) and CAN/ULC-S109 (large and small scale).
      2) Bacteria and Fungi Resistant per ASTM D3273, ASTM D6329, ASTM E2180 and ASTM G21.
      3) GREENGUARD Indoor Air Quality Certified®.
      4) GREENGUARD Children & Schools (SM) Certified.
      5) Lead free certified per RoHS.
   c. Openness Factor: 5 percent in accordance with ASHRAE 74.
   d. Thickness: 0.019 inches.
   e. Weight: 14.26 oz./sq. yd.

B. Color: As selected by Architect from manufacturer’s full range of color.

C. Seaming: None

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 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. Verify field dimensions of windows prior to fabrication of window shades.

D. Coordinate requirements for blocking, construction of shade pockets, and structural supports at historic steel windows to ensure adequate means for installation of window shades.

E. Coordinate installation of recessed shade pockets with construction of suspended gypsum board ceilings specified in Section 09500.

F. Coordinate window shade housing size, mounted depth, and required edge tolerances with construction of wall and ceiling recesses.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install roller shades level, plumb, square, and true. Allow proper clearances for window operation hardware.

C. Shade pockets:
1. Install shade pockets prior to installation of suspended ceiling system. Attach to supporting structure with screws through top of pocket at 24 inches (610 mm) minimum centers.
2. Install shade pockets in conjunction with installation of suspended ceiling system. Attach to supporting structure with screws through top of pocket at 24 inches (610 mm) minimum centers.
3. Install corner pieces securely and in alignment with pockets.
4. Install pocket ends securely and in alignment with pockets.
5. After interior construction is essentially complete, install shade and operating mechanism in pocket.

3.04 TESTING AND DEMONSTRATION

A. Demonstrate operation of shades to Owner's designated representatives.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.06 SCHEDULES

A. Refer to Section 2.02 of this specification for shade types and locations. Field verify all window openings and conditions prior to fabrication of window shades and recesses ceiling box housing, motor and components.

END OF SECTION

SECTION 00 00 00 - TABLE OF CONTENTS

DIVISION 21


211300 FIRE SUPPRESSION SYSTEMS


DIVISION 22


221116 DOMESTIC WATER PIPING
221119 DOMESTIC WATER PIPING SPECIALTIES
221316 SANITARY WASTE AND VENT PIPING
221319 SANITARY WASTE PIPING SPECIALTIES
224000 PLUMBING FIXTURES

DIVISION 23


230010 MECHANICAL GENERAL PROVISIONS
230020 MECHANICAL CLOSE-OUT REQUIREMENTS
230030 DEMONSTRATION AND TRAINING FOR MECHANICAL SYSTEMS
230500 BASIC MECHANICAL MATERIALS AND METHODS
230513 MOTORS AND CONTROLLERS
230519 METERS AND GAUGES
230523 VALVES
230529 HANGERS AND SUPPORTS
230553 MECHANICAL IDENTIFICATION
230593 TESTING, ADJUSTING, AND BALANCING FOR HVAC
230713 DUCT INSULATION
230719 PIPING AND EQUIPMENT INSULATION
230900 ENERGY MANAGEMENT AND CONTROL SYSTEM – GENERAL
230913 EMCS BASIC MATERIALS AND DEVICES
230916 EMCS OPERATOR INTERFACES
230919 EMCS FIELD PANELS
230923 EMCS COMMUNICATION DEVICES
230926 EMCS SOFTWARE AND PROGRAMMING
230933 EMCS COMMISSIONING
232113 HYDRONIC PIPING
232116 HYDRONIC PIPING SPECIALTIES
233113 METAL DUCTS
233300 AIR DUCT ACCESSORIES
233700 AIR OUTLETS AND INLETS
234000 AIR CLEANING DEVICES
238146 WATER-SOURCE UNITARY HEAT PUMPS
238416 DEHUMIDIFERS


END OF SECTION

SECTION 21 13 00 - FIRE SUPPRESSION SYSTEMS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 WORK INCLUDED

A. This section is a performance specification section only. The design build fire protection contractor shall be fully responsible for the design and to provide necessary equipment and hardware per the AHJ's and Owner's Insurance Underwriter's requirements.

B. Furnish all labor, materials, tools, and equipment to modify the existing fire suppression systems (automatic fire sprinkler system and standpipe systems), ready for service to the entire satisfaction of the Owner, Architect, Authority Having Jurisdiction (AHJ) and Owner's Insurance Underwriter. Provide hydraulically calculated systems as defined in the adopted edition of NFPA 13 and NFPA 14 and in accordance with the AHJ and Owner's insurance requirements.

C. Fire Sprinkler System Notes:

1. The automatic sprinkler system shall conform to the requirements of the adopted edition of NFPA Standard 13.
2. The standpipe and hose systems shall conform to the requirements of the adopted edition of NFPA Standard 14.
3. Provide a complete automatic fire sprinkler system for all interior spaces, interstitial spaces, etc. as required for a comprehensive fire sprinkler system.
4. Installation of the sprinkler system shall not be started until complete plans and specifications including water supply design information and type of existing sprinkler system, if any have been submitted and approved by the State Fire Marshal, Fire/Life Safety Section. At various stages and upon completion, the system must be tested in the presence of the Inspector of Record (IOR) and/or AHJ.

D. Verify electrical requirements of flow switches, valve supervision switches, etc. with electrical contractor.

### 1.3 RELATED WORK AND REQUIREMENTS

A. All Division 21, 22 and 23 sections.

B. Section 230010 – Mechanical General Provisions.

C. Division 26, Fire Alarm System Sections.

1.4 REFERENCE STANDARDS

A. American National Standards Institute (ANSI).

1. B16.1 Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
2. B16.3 Malleable-Iron Castings.
3. B16.4 Cast-Iron Threaded Fittings Class 125 and 300.
4. B16.5 Pipe Flanges and Flanged Fittings.
5. B16.9 Factory-Made wrought Steel Butt welding Fittings.
6. B16.11 Forged Fittings, Socket-Welding and Threaded.
7. B16.22 Wrought Copper and Bronze Solder Joint Pressure Fittings.
8. B16.25 Butt welding Ends.

B. American Society for Testing and Materials (ASTM).

1. A36 Structural Steel.
2. A47 Ferritic, Malleable Iron Castings.
3. A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated.
4. A135 Specification for Electric-Resistance-Welded Steel Pipe.
5. A194 Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High-Temperature Service.
6. A320 Specification for Alloy Steel Bolting Materials for Low-Temperature Service.
7. A795 Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
8. B88 Seamless Copper Water Tube.

C. American Water Works Association (AWWA).

1. DDC104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. C110 Gray Iron and Ductile Iron Fittings.
3. C111 Rubber Gasket Joints for Ductile-Iron and Grey-Iron Pressure: Pipe and Fittings.
4. C151 Thickness of Ductile-Iron Pipe – Centrifugally Cast.
5. C200 Steel Water Pipe 6” and larger.
6. C503 Wet-Barrel Fire Hydrants.

D. International Association of Plumbing and Mechanical Officials (IAPMO).

1. PS 31 Backflow Prevention Devices.

E. National Fire Protection Association (NFPA).

1. 13 – Standard for the Installation of Sprinkler Systems.
2. 14 – Standard for the Installation of Standpipe and Hose Systems.

F. Underwriter’s Laboratory (UL).

1. 262 Gate Valves for Fire Protection Service.

2. Indicator Post for Fire-Protection Service.

1.5 DESIGN CRITERIA

A. Design sprinkler systems and obtain approval from AHJ.

B. Determine the static and residual pressure for the site as required for accurate determination of system requirements. Base system calculations on the lowest expected static and residual pressure for the area.

1. Test data for static and residual pressure shall be measured by the Contractor. Test shall be made within the presence of the Architect and at a time approved by the Architect and Owner.

C. It is the intent of these Specifications and Drawings to provide for a complete and operating automatic fire protection sprinkler system in full compliance with the standards of the National Fire Protection Association as set forth in NFPA 13, and NFPA 14, currently adopted editions.

D. Review Architectural and Structural Drawings to determine the extent of construction and resultant fire protection coverage to comply with NFPA. Interstitial spaces, if utilized, will require sprinkler protection.

E. Provide fire sprinklers to protect all building overhangs greater than 4 feet wide, or as required by local authority.

F. Provide additional fire sprinklers where required to meet the requirements of NFPA13 and/or AHJ(s). Coordinate with the work of other trades especially when it may create interferences and or obstructions requiring special protection, additional piping and heads and drains.

G. The maximum permissible flow velocity through automatic sprinkler piping shall be 15 feet per second. The minimum starting pressure at the most remote sprinkler head shall be not less than the minimum required to operate the sprinkler head.

H. Reduction in area of operation when use of quick response sprinkler heads as defined in NFPA 13 will not be allowed.

I. Use of piping lighter than Schedule 10 is not allowed.

J. The initial building shall contain basic sprinkler coverage which can be modified and extended for the future build-out of unimproved spaces.

K. Design shall comply with the Owner’s Insurance Underwriters’ requirements.

1.6 COORDINATION/SPECIAL CONSIDERATIONS

A. Coordinate with other trades all equipment locations, pipe, duct and conduit runs, electrical outlets and fixtures, air inlets and outlets, and structural and architectural features. Provide information on location of piping and bracing to all other trades as required for a completely coordinated project.

B. Contract Drawings: All piping and sprinkler heads required for the sprinkler and standpipe systems are not shown.

C. Where heads are located at suspended ceiling, spacing shall be as required by NFPA 13, except as follows: In all locations, sprinkler heads shall be equidistant between lights, between wall and lights, between lights and air diffusers, and between wall, lights, and air diffusers. Provide uniform and repetitive pattern for each room. Locate by reflected ceiling plan where shown.

D. Install sprinkler all sprinkler heads in center of ceiling tiles.

E. Provide approved dry pendant sprinkler heads in spaces subject to freezing.

F. Provide high temperature sprinkler heads in all electrical rooms or other areas with elevated temperatures such as mechanical rooms.

G. Coordinate Work among the trades in accordance with Division 01 avoid any interference with the effectiveness of the fire protection system. Shop drawings shall include elevations of equipment and piping to assure coordination. The fire protection system shall be coordinated with other trades to assure that conflicts will not arise with structural, mechanical, electrical, or architectural features of the building.

H. Coordinate with the fire alarm contractor to ensure full awareness of the location of control valves, flow switches, tamper switches, and alarm and signal switches.

1.7 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of fire protection products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: A firm with at least five years of successful installation experience on projects with fire sprinkler piping similar to that required for this project.

C. Requirements of Regulatory Agencies:

1. Install fire protection systems in accordance with IBC – 2012 Edition, Chapter 9 “Fire Protection Systems”.
2. NFPA Compliance: Install fire protection systems in accordance with NFPA 13 "Standard for the Installation of Sprinkler

Systems", and other applicable NFPA requirements. Additionally, comply with NFPA 14 "Standard for the installation of Standpipe and Hose Systems".

3. FM Compliance: Comply with Factory Mutual "Approval Guide".
4. UL Labels: Provide fire sprinkler piping products which have been approved and labeled by Underwriters' Laboratories.
5. Fire Marshal Compliance: Install fire protection systems in accordance with Fire Marshal or other AHJ.
6. Owner's Insurance Underwriter's Compliance: Install fire protection systems in accordance with Owner's Insurance Underwriter's requirements.
7. Screw Thread Connections: Comply with local fire department/marshal regulations for sizes, threading, and arrangement of connections for fire department equipment to systems.

D. Firestop penetrations with an approved material as prescribed in the International Building Code (IBC).

E. Installation of the sprinkler system shall not be started until complete plans and specifications (including water supply information and type of existing sprinkler system, if any) have been reviewed and approved by the AHJ and the Owner's Insurance Underwriter.

F. At various stages and upon completion, the system must be tested in the presence of the enforcing agency.

G. The fire extinguishing system shall be installed by a licensed fire systems contractor.

## 1.8 SUBMITTALS

A. See Section 230010 Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop and coordination drawings according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Pipe, fittings, valves | R | | | |
| Sprinkler heads | R | | | R |
| Gauges | R | | | R |
| Sleeves and Escutcheons | R | | | |
| Flow and tamper switches | R | | | R |
| Pipe hangers and supports | R | | | R |
| Identification signs | R | | | |
| Sprinkler head cabinets | R | | | R |

| | | | | |
|---|---|---|---|---|
| Hose Valve cabinets | R | | | R |
| Coordination drawings | | | | R |
| AHJ approval letter | | | | R |
| Insurance Underwriter’s approval letter | | | | R |
| Hydraulic calculations | | | | R |
| Static and residual flow tests results | | | | R |

C. Submit shop drawings as follows:

1. Prepare and submit preliminary drawing to the Owner showing the proposed location of the fire sprinkler heads coordinated with and in relation to the ceiling tile pattern, light fixture, and duct inlets/outlets. Review of this drawing and the AHJ’s review stamp thereon shall be a prerequisite for the preparation of further working plans.
2. Detailed working drawings and hydraulic calculations shall be prepared and submitted for approval before fabrication of the project. Working drawings shall be submitted in complete sets (partial submission will not be acceptable) and shall bear the Contractor's license stamp, identity of the system designer and computer program used in the calculation of hydraulic information.
3. AHJ approval of submittals is for permission to proceed and does not authorize design, products or installation not conforming to referenced codes and standards and this specification. Substitutions or alternates require specific approval by the Owner.
4. Upon completion of the Work, the Contractor shall provide AutoCAD Record Drawings to the Architect. Refer also to Division 01. Final approvals are subject to receipt of acceptable Record Drawings.

D. Submittals having any content that is incomplete or unclear will be returned without review or approval.

E. Deferred Approval Documents: Do not proceed with fabrication or installation of fire sprinkler system until deferred approval documents have been approved by AHJ and Architect.

1. General: Provide detailed drawings, specifications, hydraulic calculations, and any other documentation as required by the AHJ and Owner’s insurance underwriter.
2. Make additions, changes and corrections as directed by Architect and resubmit.
3. Agency Review: Submit documents to Owner and/or AHJ. Make additions, changes and corrections required by Owner / AHJ at no cost to Owner and resubmit to Architect.

F. Provide all necessary information to ceiling suspension work of Division 09, Finishes, to provide coordinated submittals.

G. Discharge patterns and application data shall be included in submittals for sidewall, water curtain, and similar special purpose sprinklers.

H. Operating Instructions: Provide instruction charts describing operation and proper maintenance of system equipment per Division 01 and Section 230010 Mechanical General Provisions.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure rating, temperature ratings, and capacities as required. Provide sizes and types matching piping and equipment connections; provide fittings of materials that match pipe materials used in fire protection systems.

B. Equipment to be furnished under this specification shall be essentially standard product of manufacturer. Where two or more units of same class of equipment are required, these units shall be products of a single manufacturer. However, component parts of system need not be products of same manufacturer.

C. Manufacturers: Subject to compliance with requirements, manufacturer offering automatic sprinklers which may be incorporated in the work include the following:

1. Specialty Valves and Devices:

    a. Badger Fire Protection Inc.
    b. Grinnell Corp.
    c. Viking Corp.
    d. Or equal.

2. Water-Flow Indicators and Supervisory Switches:

    a. Grinnell Corp.
    b. Potter Electric Signal Co.
    c. Viking Corp.
    d. Or equal.

3. Sprinkler, Drain and Alarm Test Fittings:

    a. Central Sprinkler Corp.
    b. Grinnell Corp.
    c. Victaulic Co.
    d. Or equal.

4. Sprinkler, Branch-Line Test Fittings:

    a. Elkhart Brass Mfg. Co. Inc.
    b. Smith Industries, Inc.; Potter-Roemer Div.
    c. Or equal.

5. Sprinkler, Inspector's Test Fittings:

    a. G/J Innovations Inc.

b. Triple R Specialty of Ajax Inc.

6. Fire Department Connections:

a. Badger Fire Protection, Inc.
b. Elkhart Brass Mfg. Co. Inc.
c. Grinnell Corp.
d. Or equal.

7. Sprinklers:

a. Badger Fire Protection Inc.
b. Grinnell Corp.
c. Viking Corp.
d. Or equal.

8. Fire-Protection-Service Valves:

a. Grinnell Corp.
b. McWane Inc.; Kennedy Valve Div.
c. Nibco Inc.
d. Or equal.

9. Grooved-End Fittings for Steel Piping:

a. Victaulic Co.
b. Or equal.

## 2.2 VALVE AND ALARM SYSTEM IDENTIFICATION

A. Provide identification complying with Section 230553 Mechanical Identification section in accordance with the following listing:

1. Fire Protection Valves: Brass valve tags.
2. Fire Protection Signs: Provide the following signs:

a. At each sprinkler valve, including roof manifold, sign indicating what portion of system valve controls.
b. At each outside alarm device, sign indicating what authority to call if device is activated.

## 2.3 BASIC PIPES AND TUBES

A. Piping shall be new, designed for 300 psi working pressure, conforming to ASTM specifications and have the manufacturer’s name or brand along with the pipe applicable ASTM standard marked on each length of pipe.

B. All piping shall be UL listed and FM approved.

C. Piping installed above ground 2 inch and smaller shall be Schedule 40 black steel pipe. Pipe shall be manufactured in accordance with specifications ASTM A-135 and A-53.

D. Piping installed above ground 2-1/2 inch and larger shall be Schedule 10 black steel pipe. Pipe shall be manufactured in accordance with specification ASTM A 135.

E. All fire protection piping shall be provided with factory-applied antimicrobial coatings to inhibit Microbiologically Influenced Corrosion (MIC). Allied Tube and Conduit "ABF II", Wheatland Tube Company "MIC Shield" or equal.

F. Sprinkler piping and fittings exposed to weather, used in a corrosive atmosphere, or as noted on drawings shall be galvanized.

G. In-Building Risers shall be installed as indicated on the plans. Risers shall be composed of a single extended 90-degree fitting of fabricated 304 stainless steel tubing, maximum working pressure 300 psi. The fitting shall have a grooved-end connection on the outlet (building) side and a CIPS coupler on the inlet (underground) side. The In-Building Riser shall be an Ames Fire & Waterworks Series IBR (or equal).

## 2.4 PIPE AND TUBE FITTINGS

A. Cast-Iron Threaded Flanges: ASME B16.1.

B. Cast-Iron Threaded Fittings: ASME B16.4.

C. Ductile-Iron Fittings: ASTM A47, malleable-iron or ASTM A 536 ductile-iron casting complying with AWWA pipe size; with ends factory grooved according to AWWA C606.

D. Malleable-Iron Threaded Fittings: ASME B16.3.

E. Steel, Threaded Couplings: ASTM A 865.

F. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.

G. Steel Flanges and Flanged Fittings: ASME B16.5.

## 2.5 PIPING SPECIALTIES

A. Provide piping specialties in accordance with the following listing:

1. Pipe escutcheons.
2. Dielectric unions.
3. Pipe sleeves.
4. Sleeve seals.

## 2.6 JOINING MATERIALS

A. Grooved-End Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel pipe OD. Include ductile-iron housing with keys matching steel pipe fitting

grooves, pre-lubricated rubber gasket listed for use with housing and steel bolts and nuts. Include listing for dry-pipe service for couplings for dry piping.

B. Steel, Grooved-End Fittings: UL-listed and FM approved, ASTM A47, malleable iron or ASTM A 536, ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

C. Transition Couplings: AWWA C219, sleeve type, or other manufactured fitting the same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

## 2.7 POLYETHYLENE ENCASEMENT

A. Polyethylene Encasement for Ductile-Iron Piping: ASTM A674 or AWWA C105 film, 0.008-inch minimum thickness, tube, or sheet.

## 2.8 SUPPORTS AND ANCHORS

A. Spacing and details of the support and bracing of fire sprinkler piping shall comply with the currently adopted edition of NFPA 13. U-hook hangers used as sway bracing must have legs bent out 10 degrees and must have a slenderness ratio not exceeding 200.

B. Concrete Inserts: Uni-Strut P-3200 continuous insert or M24 spot insert Kin-line or equal. Do not use powder actuated fasteners for support of overhead piping unless approved by Architect.

## 2.9 VALVES

A. Provide valves, UL listed, and FM approved, in accordance with the following listing. Provide sizes and types which mate and match piping and equipment connections.

1. Gate Valves: Provide iron gate control valve, outside screw and yoke (OS&Y), 175-lb rated working pressure, of sizes indicated, to close by turning to the right and to be sealed with approved metal seals. Valves shall be iron body, bronze fitted. Valves 2 inches and smaller shall be screwed and valves over 2 inches shall be flanged. For reference purposes, Mueller A-2073-6. Grinnell, Kennedy, Stockham or equal.
2. Butterfly Valve: Provide UL listed FM approved butterfly valves (slow-close) with position indicators. Electric motor operated valves shall be normally open and shall fail in the open position. For reference purposes, Mueller B-3211. Grinnell, Kennedy, Stockham or equal.
3. Swing Check Valves: Provide UL listed flanged, swing type, iron body, bronze seat ring and disc ring, and 175 psi pressure rating. For reference purposes, Mueller A-2120-6, Grinnell, Kennedy, Stockham or equal.
4. Riser Drain Valves: Main Riser Drain valves shall be angle or
5. Auxiliary Drain Valve: Valves for auxiliary drains and Owner's Test connections shall be globe type, bronze body, screwed, 200

psi pressure rating, 1 inch size, with a renewable composition soft disc, For reference purposes, Grinnell 3210, Stockham, NIBCO, Fairbanks or equal.

6. Indicating Valves, 2-1/2 inches and Smaller: UL 1091; butterfly or ball-type, bronze body with threaded ends; and integral indicating device.
7. Swing Check Valves, 2 inches and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc and threaded ends.
8. Swing Check Valves, 2-1/2 inches and Larger: UL 312, cast-iron body, and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring and flanged ends.
9. Split-Clapper Check Valves, 4 inches and Larger: UL 312, cast-iron body with rubber seal, bronze-alloy discs, and stainless-steel spring and hinge pin.
10. For other valves not required to be UL listed and FM approved refer to Section 230523 Valves.

## 2.10 METERS AND GAUGES

A. Provide meters and gauges complying with Section 230519 Meters and Gauges, in accordance with the following listing:

1. Pressure gauges: UL 393, 3-1/2- to 4-1/2-inch- diameter dial with dial range of 0 to 300 psig.

## 2.11 SPECIALTY VALVES

A. Sprinkler System Control Valves: UL listed or FMG approved cast or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.

1. Available Manufacturers:

   a. Grinnell Corp.
   b. Victaulic Co.
   c. Viking Corp.
   d. Or equal.

2. Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.

   a. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

3. Ball Drip Valves: UL 1726, automatic drain valve, NPS 3/4, ball check device with threaded ends.

2.12 FIRE PROTECTION SPECIALTIES

A. Provide fire protection specialties, UL listed, in accordance with the following listing. Provide sizes and types that match piping and equipment connections.

1. Install drains on main risers and auxiliary drains at all low points in the system.
2. One Owner's test drain shall be installed for each sprinkler system.
3. Drains and Owner's tests shall be at locations approved by the Architect.
4. Drains and Owner's tests shall be installed at locations as shown on the Drawings.
5. Provide drain line to floor sink or to outside, as required, to suit Project conditions.
6. Five or fewer trapped heads will not require a drain valve but may be drained through a plugged fitting.
7. Drain valve shall be of the angle type. Install in accordance with the requirements of NFPA Pamphlet No. 13.
8. Pipe drain valves to a floor sink or to the outside of the building. Discharge shall be visible from sight drain fitting or open end drain pipe. Provide flushing connections at ends of all cross mains.
9. Flow Alarm: Furnish and install a flow alarm system for each main sprinkler riser as shown on the Drawings. The systems shall be complete with Grinnell F-620, Viking or equal, flow switch. As part of Division 26, wire flow alarm to the fire alarm control panel. Provide 3/4-inch conduit and two #14 wires from the tamper switch to the fire department control panel.
10. Provide wiring between switch, bell, and junction box. Provide junction box under Division 26. Wiring shall meet the requirements of Division 26. All controls shall be identified by permanent metal tags or other approved means. Alarm switch shall be UL or FM approved and shall have adjustable retard mechanism and two sets of contacts. Wiring between electrical distribution panel and junction box will be provided under Division 26.
11. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250-psig pressure rating; and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
12. Pressure Switches: UL 753; electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts, and design that operates on rising pressure and signals water flow.
13. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position, Grinnell Model F640, Viking or equal, with single pole double throw switch actuator installed to change switch position when OS&Y valve is being closed.
14. Indicator-Post Supervisory Switches: UL 753; electrical; single-pole, double throw, with normally closed contacts. Include design

that signals controlled indicator-post valve is in other than fully open position.

15. As part of Division 26, wire supervisory switch to the fire alarm control panel. Provide 3/4-inch conduit and two #14 wires from the tamper switch to the fire department control panel.

## 2.13 AUTOMATIC SPRINKLERS

A. Provide automatic sprinklers in accordance with the following listing. Provide fusible links for 165 degrees F. unless otherwise noted; UL or FM approved.

B. Automatic Sprinklers: With heat-responsive element complying with the following:

1. UL 199, for applications except residential.
2. UL 1767, for early suppression, fast-response applications.

C. Type: Spray pattern type, automatic closed-type heads of ordinary degree temperature rating, except that sprinklers to be installed in vicinity of heating equipment shall be of temperature ratings required for such locations by the currently adopted edition of NFPA 13.

1. Flush ceiling sprinklers, including escutcheon.
2. Pendent, dry-type sprinklers.
3. Quick-response sprinklers.
4. Sidewall, dry-type sprinklers.
5. Upright sprinklers.
6. Concealed ceiling sprinklers, including cover plate.

D. Sprinkler heads shall be UL or FM listed.

1. Exposed Locations: Provide upright type heads at all areas with no finished ceilings.
2. Where heads are located at height of less than 8 feet above finished floor, or where heads are located in mechanical equipment areas, provide wire guards to protect heads from damage.
3. Concealed Locations: Provide upright-type heads or pendent-type heads.
4. Sidewall Locations: Where required and, where approved by the Architect.
5. Finished Ceilings: Locate at all ceilings with lay-in acoustical tile ceiling and at plaster or gypsum board type ceilings. Provide satin chrome finish and adjustable chrome finish metal ceiling escutcheons. Provide fully recessed pendant type and white enamel metallic cover in ceilings of finished spaces.
6. Where fire sprinkler heads are located in rooms with surface mounted lights, provide 2-piece adjustable sprinkler escutcheon, with adjustment from 1-7/8" to 3-1/8" below finished ceiling. Fire sprinkler drop nipple should be mounted 2-1/4" below the finished ceiling surface.
7. Sprinkler heads in light hazard area shall be quick response type.
8. Extended coverage sprinklers shall not be used.

E. Sprinkler Finishes: Chrome-plated, bronze, and painted.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

H. Sprinkler Cabinet and Wrench: Furnish steel, baked red enameled, sprinkler box with capacity to store sprinklers and wrench sized to sprinklers. Spare sprinklers and wrenches called for under "Extra Stock."

## 2.14 SPECIALTY SPRINKLER FITTINGS

A. Specialty Fittings: UL listed, and FM approved; made of steel, ductile iron or other materials compatible with piping.

B. Drop-Nipple Fittings: UL 1474, with threaded inlet, threaded outlet, and seals; adjustable.

C. Sprinkler, Drain and Alarm Test Fittings: UL-listed, cast- or ductile-iron body; with threaded inlet and outlet, test valve, and orifice and sight glass.

D. Sprinkler, Branch-Line Test Fittings: UL-listed, brass body; with threaded inlet and capped drain outlet and threaded outlet for sprinkler.

E. Sprinkler, Inspector's Test Fittings: UL-listed, cast- or ductile-iron housing; with threaded inlet and drain outlet and sight glass.

F. Flexible Hose Assemblies: FlexHead Industries flexible stainless steel hose assembly consisting of a mounting bracket and a one-piece, leak tested sprinkler drop. The mounting bracket shall be compatible with any suspended or gypsum board ceiling system and FM/UL approved sprinklers. Assembly shall be FM approved and UL listed for use intended. Lengths of assemblies shall be selected with minimum length required to connect sprinkler without loops, traps, etc.

# PART 3 - EXECUTION

## 3.1 PRODUCT HANDLING AND PROTECTION

A. Deliver packaged materials in their original, unopened wrapping with labels intact. Protect materials from water, the elements and other damage during delivery, storage, and handling.

3.2 PREPARATORY PROVISIONS

A. The Contractor shall be responsible for the examination and acceptance of all conditions affecting the proper construction and/or installation of the Work of this Section and shall not proceed until all unsatisfactory conditions have been corrected. Commencing work shall be construed as acceptance of all conditions by the Contractor as satisfactory for the construction and/or installation of the Work

B. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations.

C. Report test results promptly and in writing

3.3 PIPING APPLICATIONS

A. Do not use welded joints with galvanized steel pipe.

B. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

C. Piping between Fire Department Connections and Check Valves: Use galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.

D. Underground Water Supply and Service-Entrance Piping: Use ductile-iron, mechanical-joint pipe and fittings and restrained joints. Include corrosion protective encasement. Use In-Building Riser for service-entrance piping

3.4 SPRINKLER SYSTEM PIPING APPLICATIONS

A. Pipe and Fitting Schedule:

1. 1-1/2 inches and Smaller: Standard-weight black steel pipe with threaded ends, cast-or malleable-iron threaded fittings, and threaded joints.
2. 2-inch: Standard-weight black steel pipe with threaded ends, cast- or malleable-iron threaded fittings, and threaded joints.
3. 2-inch: Standard-weight black steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
4. 2-1/2 to 3-1/2 inches: Schedule 40 black steel pipe with threaded ends, cast- or malleable-iron threaded fittings, and threaded joints.
5. 2-1/2 to 3-1/2 inches: Schedule 10 black steel pipe with roll-grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
6. 2-1/2 to 3-1/2 inches: Schedule 30 black steel pipe with plain ends, steel welding fittings, and welded joints.
7. 4-inch: Schedule 40 steel pipe with threaded ends, cast-or malleable-iron threaded fittings, and threaded joints.

8. 4-inch: Schedule 10 black steel pipe with roll-grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
9. 4-inch: Schedule 40 black steel pipe with plain ends, steel welding fittings, and welded joints.
10. 5 and 6 inches: Standard-weight black steel pipe with threaded ends, cast- or malleable-iron threaded fittings, and threaded joints.
11. 5 and 6 inches: Standard-weight black steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
12. 5 and 6 inches: Standard-weight black steel pipe with plain ends, steel welding fittings, and welded joints.

## 3.5 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Fire-Protection-Service Valves: UL listed, and FM approved for applications where required by NFPA 13.

   a. Shutoff Duty: Use gate valves.

2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 13.

   a. Shutoff Duty: Use gate, ball, or butterfly valves.
   b. Throttling Duty: Use globe, ball, or butterfly valves.

## 3.6 JOINT CONSTRUCTION

A. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

B. Steel-Piping, Grooved Joints: Use Schedule 10 steel pipe with cut or roll-grooved ends and Schedule 30 or Schedule 10 steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

C. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.

1. 2 inch and Smaller: Use dielectric couplings or nipples.
2. 2-1/2 to 4 inches: Use dielectric flanges.
3. 5 inch and Larger: Use dielectric flange insulation kits.

D. Dissimilar-Piping-Material Joints: Construct joints using adapters or couplings compatible with both piping materials. Use dielectric

fittings if both piping materials are metal. Refer to Section 230500 Basic Mechanical Materials and Methods for dielectric fittings.

## 3.7 INSTALLATION OF FIRE SPRINKLER PIPING

A. General: Comply with the requirements of the Division 21, 22 and 23 sections and referenced NFPA standards for installation of fire sprinkler piping material. Install fire sprinkler piping products where shown, in accordance with the manufacturer's written instructions, and in accordance with recognized industry practices to ensure that fire sprinkler piping complies with requirements and serves its intended purpose.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Coordination: Coordinate all piping, heads, and sprinkler work to Architectural, Structural, Mechanical, and Electrical Work. Conceal piping, except where so indicated otherwise, or where absolutely necessary. Place exposed piping where required by the Architect. Provide any offsets or additional piping required to coordinate this system with all other Work.

1. If piping is installed such that it is exposed to view in any location normally available to the users of the building or the public, it shall be relocated and concealed to the Architect’s satisfaction, and at no additional cost to the Owner.

D. Any differences or disputes concerning coordination, interference, head and pipe locations or extent of work shall be decided by Architect and his decision shall be final.

E. Supply System: Provide supply connections as required to service the sprinkler system.

1. Installation shall conform to the applicable requirements of NFPA 13 and IBC.
2. Make joints as specified herein and in a manner approved by Architect. Leave joints exposed until final inspection and tests have been made.
3. Brace or clamp bends in accordance with the requirements. The clamp rods at the flange and spigot piece shall be long enough to pass through the flange.
4. Before connection of sprinkler system to underground supply, flush supply connections out thoroughly in accordance with NFPA.

F. Supply System: Provide supply connections as required to service the sprinkler system.

1. Install pipe, fittings, and hangers in accordance with requirements of IBC current adopted edition, "Fire Protection Systems".
2. Cutting structural members for passage of sprinkler piping or for pipe hanger fastening will not be permitted except on review of Architect for each specific case.
3. Holes through walls, floors, and ceilings shall be large enough to accommodate pipe expansion. Provide suitable plates at each hole to ensure the effectiveness of floor or wall as a fire stop. Foundation penetration shall have a 2-inch annular space around pipe sealed watertight.
4. Provide long runs of pipe with suitable means to permit free movement due to expansion and contraction.
5. Make reduction in pipe sizes with one-piece concentric tapered reducing fittings. Bushings will not be acceptable.
6. Couplings shall not be used except where the length of pipe between fittings exceeds 20 feet 0 inches.
7. Use flanged fittings in control valves and drain assembly and at the base of risers.
8. Use malleable iron unions of the ground joint type in looped sprinkler systems where pipe is 2 inches in diameter or smaller. Where loops larger than 2 inches are used, companion flanges shall be installed.
9. Special couplings approved for use in sprinkler systems may be used in place of unions and flanged connections where applicable.
10. Install sectional valves in inlet piping, at bottom of each riser, and in all loops as required.
11. Mount supervisory switches on each sectional valve.
12. Install pressure gages at top of each standpipe.
13. Install valved hose connections 3/4-inch size on sprinkler at ends of branch lines and cross mains.
14. Install Owner's test connection at most remote point from riser.

G. Install ductile iron underground water supply and service-entrance piping according to NFPA 24 and with restrained joints. Encase piping in corrosion-protective encasement.

H. Install unions adjacent to each valve in pipes 2 inches and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

I. Install flanges or flange adapters on valves, apparatus, and equipment having 2-1/2 inches and larger connections.

J. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.

K. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to sprinkler risers when sprinkler branch piping is connected to sprinkler risers.

L. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

M. Install sectional valves in piping.

N. Mount supervisory switches on each sectional valve.

O. Install valved hose connections of the sizes indicated, or 3/4-inch size, if not otherwise indicated, on sprinklers at ends of branch lines and cross mains at locations where indicated.

P. Install drain piping at low points of fire sprinkler piping.

Q. Identification: Apply signs to control, drain, test and alarm valves to identify their purpose and function. Provide lettering size and style selected by Authority Having Jurisdiction.

R. Hangers and Supports: Comply with NFPA 13 for hanger materials and installation.

S. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.

T. Install new pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe, valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing.

U. Fill wet-pipe sprinkler and standpipe system piping with water.

## 3.8 SPECIALTY SPRINKLER FITTING INSTALLATION

A. Install specialty sprinkler fittings according to manufacturer's written instructions.

## 3.9 VALVE INSTALLATION

A. Refer to Section 230519 Valves for installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13, manufacturer's written instructions, and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:

1. Alarm Check Valves: Install in vertical position for proper flow, including bypass check valve and retarding chamber and drain-line connections.

## 3.10 SPRINKLER APPLICATIONS

A. General: Use sprinklers according to the following applications:

1. Rooms with Suspended Ceilings: Concealed sprinklers.
2. Mechanical Rooms, Basement, and Central Plant: Upright sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
5. Special Applications: Use extended-coverage, flow-control, and quick-response sprinklers were applicable.
6. Sprinkler Finishes: Use sprinklers with the following finishes:

    a. Upright, Pendent, and Sidewall Sprinklers: Polished bronze in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.
    b. Concealed Sprinklers: Rough brass with white cover.

## 3.11 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

D. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

E. Connection of alarm devices to fire alarm system by Division 26 Contractor.

F. Ground equipment according to Division 26.

G. Connect wiring according to Division 26.

H. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

## 3.12 SLEEVES AND FLASHINGS

A. All sleeves shall be properly anchored in place during pouring of slabs. All pipe sleeves through water resistant floors shall extend at least 1-1/2 inches above the finished floor and shall be watertight with the pipes passing through the sleeves. Sleeves passing through all other floors shall be of sufficient length to be flush with bottom of slab and extend one inch above the finished floor and shall be securely anchored to the slab.

B. All piping passing through membrane water resistant walls and floors shall be provided with a water-resistant type pipe sleeve, with Schedule 40 pipe extension or equal. Pack water resistant sleeves with white oakum and mastic.

C. Wherever pipes are exposed and pass-through walls, floors, partitions or ceilings, they shall be fitted with chromium plated cast steel escutcheons held in place with setscrews. Care shall be taken to protect the escutcheons during the course of construction.

D. Sleeves in masonry or other walls shall be put in place as the construction progresses, avoiding the cutting of completed work.

E. All piping passing through fire-rated assemblies shall be installed within fire-rated pipe sleeves.

## 3.13 INSPECTION

A. Examine areas and conditions under which fire protection materials and products are to be installed.

B. After completion of the fire protection installation and at the start of the guarantee period, execute the National Automatic Sprinkler and Fire Control Association, Inc. standard form of "Inspection Agreement", at no increase in Contract Sum, calling for four inspections of the sprinkler system during the guarantee year, plus the following maintenance to be performed during the course of the fourth inspection.

1. Operating of all control valves.
2. Lubrication of operating stems of all control valves.
3. Operating of electrical alarms.
4. Cleaning of alarm valves.
5. Lubrication of Fire Department hose connection inlets.

C. Fill out "Inspection Agreement" in triplicate after each inspection and send copies to the Owner, Insurance Carrier, and Fire Department.

D. Welding inspection of the sprinkler system is to be done by the Architect.

## 3.14 INSTALLATION OF BASIC IDENTIFICATION

A. Install mechanical identification in accordance with Section 230553.

B. Install fire protection signs on piping in accordance with NFPA requirements.

C. Paint all exposed piping and including fire protection riser, color shall be selected by the Architect. See Division 09 Painting.

3.15 FIELD QUALITY CONTROL

A. Sprinkler Piping Flushing: Prior to connecting sprinkler risers for flushing, flush water feed mains, lead-in connections, and control portions of sprinkler piping. After fire sprinkler piping installation has been completed and before piping is placed in service, flush entire sprinkler system as required to remove foreign substances under pressure as specified in NFPA 13. Continue flushing until water is clear, and check to ensure that debris has not clogged sprinklers.

B. Hydrostatic Testing: After flushing system, test fire sprinkler piping hydrostatically for period of 2 hours at not less than 200 psi or at 50 psi greater than system pressure where pressure is anticipated to be in excess of 150 psi. Check system for leakage of joints. Measure hydrostatic pressure at low point of each system or zone being tested.

C. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Architect. At completion, carefully clean and adjust equipment and trim that are installed as part of this work. Leave systems and equipment in satisfactory operating condition. Repair or replace piping system as required to eliminate leakage in accordance with NFPA standards for "little or no leakage," and retest as specified to demonstrate compliance.

3.16 EXTRA STOCK

A. Heads: For each style and temperature range required, furnish additional sprinkler heads, amounting to one unit for every 100 installed units but not less than 10 heads, in proportion to the total number of each style of head.

B. Wrenches: Furnish two sprinkler wrenches for each type and size of sprinkler connection.

C. Obtain receipt from Owner that extra stock has been received.

3.17 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers and other equipment.

B. Remove and replace sprinklers having paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

3.18 COMMISSIONING

A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

B. Verify that specified tests of piping are complete.

C. Verify that potable-water supplies have correct types of backflow preventers.

D. Verify that hose connections and fire department connections have threads compatible with local fire department equipment.

E. Fill wet-pipe standpipe piping with water.

F. Verify that hose connections are correct type and size.

G. Energize circuits to electrical equipment and devices.

H. Adjust operating controls and pressure settings.

I. Coordinate with fire alarm tests. Operate as required.

END OF SECTION

SECTION 22 11 16 - DOMESTIC WATER PIPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

B. Related Requirements:

1. Section 230010 – Mechanical General Provisions.
2. Section 230500 – Basic Mechanical Materials and Methods.
3. Section 230523 – Valves.
4. Section 230553 – Mechanical Identification.

### 1.3 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Piping and fitting materials | R | | | R |
| Solder | R | | | |
| Couplings | R | | | |
| System purging and disinfecting activities report. | | R | | |

1.4 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 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."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K 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.

2.3 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 A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## 2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: tube.

C. Color: Blue (domestic cold water), Red (domestic hot water).

## 2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

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

a. Cascade Waterworks Mfg. Co.
b. Dresser, Inc.
c. Jay R. Smith Mfg. Co.
d. Viking Johnson.
e. Or equal.

D. 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. Spears Manufacturing Company.
c. Uponor.

d. Or equal.

2. Description:

a. PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert, and one solvent-cement-socket end.

E. Plastic-to-Metal Transition Unions:

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

a. Colonial Engineering, Inc.
b. NIBCO INC.
c. Spears Manufacturing Company.
d. Or equal.

2. Description:

a. PVC four-part union.
b. Brass or stainless-steel threaded end.
c. Solvent-cement-joint plastic end.
d. Rubber O-ring.
e. Union nut.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

A. Comply with requirements in Section 312000 – Earth Moving for excavating, trenching, and backfilling.

### 3.2 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 underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gauge, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gauges in Section 230519 – Meters and Gauges and with requirements for drain

valves and strainers in Section 221119 – Domestic Water Piping Specialties.

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 230523 – Valves.

G. Install domestic water piping level and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

J. 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.

K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

L. Install piping to permit valve servicing.

M. 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.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

## 3.3 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," "Brazed 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. 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.

G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

## 3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

## 3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 230529 – Hangers and Supports.

## 3.6 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.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

## 3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 230553 – Mechanical Identification.

B. Label pressure piping with system operating pressure.

## 3.8 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 (minimum of 150 psig). 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.

## 3.9 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.

## 3.10 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. Clean non-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 procedures prescribed by authorities having jurisdiction or if methods are not prescribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

## 3.11 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.

| Service | Type of Pipe | Fittings | Joints |
|---|---|---|---|
| Above slab | Hard copper, Type L | Cast or wrought cop-per | Soldered |

## 3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping 2-1/2 inch and smaller. Use gate valves with flanged ends for piping 3 inch and larger.
2. Throttling Duty: Use ball valves for piping 2 inch and smaller. Use butterfly or ball valves with flanged ends for piping 2-1/2 inch and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

| Domestic Water Piping Test Log | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | System | Description of Piping Section Tested | Test Press. (psig) | Test Duration (hours) | Results Pass/ Fail | Witness (Contractor) Initials | Witness (Professional) Initials |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| This form stall be completed and submitted with the project closeout documents. Contractor shall copy this form if more sheets are required. Piping pressure test log shall be kept at project site and shall be made available to the Architect upon request. | | | | | | | |

END OF SECTION

# SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Balancing valves.
2. Outlet boxes.

B. Related Requirements:

1. Section 230519 Meters and Gauges for thermometers, pressure gauges, and flow meters in domestic water piping.

### 1.3 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Domestic water piping specialties (for each item) | R | R | | R |

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models are acceptable.

1. Balancing Valves.

    a. Armstrong International, Inc.
    b. ITT Corporation.
    c. NIBCO INC.
    d. Watts; a Watts Water Technologies company.
    e. Or equal.

2. Outlet Boxes.

    a. Guy Gray
    b. Watts; a Watts Water Technologies company.
    c. Zurn Industries, LLC.
    d. Or equal.

## 2.2 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G.

## 2.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

## 2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
2. Body: Brass or bronze.
3. Size: Same as connected piping, but not larger than NPS 2.

B. Cast-Iron Calibrated Balancing Valves:

1. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
2. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Memory-Stop Balancing Valves:

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

2.5 OUTLET BOXES

A. Icemaker Outlet Boxes (IMB-1):

1. Mounting: Recessed.
2. Material and Finish: Stainless-steel box and faceplate.
3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
4. Supply Shutoff Fitting: NPS 1/2 ball valve and NPS 1/2 copper, water tubing.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Install balancing valves in locations where they can easily be adjusted.

B. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in the project manual.

3.2 CONNECTIONS

A. Fire-retardant-treated-wood blocking is specified in Division 06.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Calibrated balancing valves.
2. Outlet boxes.

B. 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 230553 Mechanical Identification.

3.4 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.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

### 1.3 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Piping and fitting materials | R | | | R |
| Couplings | R | | | |

### 1.4 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

## PART 2 - PRODUCTS

### 2.1 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.

### 2.2 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.

### 2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

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

a. ANACO-Husky.
b. Charlotte Pipe and Foundry Company.
c. Or equal.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

### 2.4 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. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.

D. 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.

E. 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.

F. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

## 2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Unshielded, Non-pressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Fernco Inc.
2) Or equal.

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.
2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3) For Dissimilar Pipes: ASTM D 5926, PVC, or other material

# PART 3 - EXECUTION

## 3.1 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 drain pipe.

    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. 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; 2 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.

L. 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."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

N. Plumbing Specialties:

1. Install drains in sanitary waste gravity-flow piping.

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. Install sleeves for piping penetrations of walls, ceilings, and floors.

Q. Install sleeve seals for piping penetrations of concrete walls and slabs.

R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

## 3.2 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling 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.

## 3.3 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, non-pressure transition couplings.

## 3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 230529 – Hangers and Supports.

1. Install galvanized-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install galvanized-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
4. Vertical Piping: MSS Type 8 or Type 42, clamps.

5. 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.

6. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
7. 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 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.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

## 3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. 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. Install horizontal backwater valves in pit with pit cover flush with floor.
6. 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.

C. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

## 3.6 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 230553 – Mechanical Identification.

## 3.7 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. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections, and arrange for re-inspection.

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.

## 3.8 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. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

| Description | Pipe | Fittings | Joints |
|---|---|---|---|
| Above grade, Soil, Waste, and Vent Piping (installed in return air plenum) | Cast-iron, hubless | Hubless, DWV pattern | Heavy-duty, couplings |
| Condensate drains | Copper, Type M | Copper, DWV pattern | Soldered |

| Sanitary Waste and Vent Piping Test Log | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | System | Description of Piping Section Tested | Test Press. (psig) | Test Duration (hours) | Results Pass/ Fail | Witness (Contractor) Initials | Witness (Professional) Initials |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| This form stall be completed and submitted with the project closeout documents. Contractor shall copy this form if more sheets are required. Piping pressure test log shall be kept at project site and shall be made available to the Architect upon request. | | | | | | | |

END OF SECTION

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Through-penetration firestop assemblies.
3. Miscellaneous sanitary drainage piping specialties.

### 1.3 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Sanitary waste piping specialties (for each item) | R | R | | R |

## PART 2 - PRODUCTS

### 2.1 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.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

## 2.2 CLEANOUTS

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

1. Jay R. Smith Mfg. Co.
2. Josam Company.
3. Zurn Industries, LLC.
4. Cresline.
5. Or equal.

B. Service: Sanitary, soil and waste piping

C. Cleanouts shall be the same size as pipe except that cleanouts larger than 4 inches are not required. Install cleanouts and/or test tees at the foot of all soil, waste and drain stacks, and on each building drain outside of building. Cleanouts shall be installed every 50 feet or less on all horizontal drain lines.

D. At ends of horizontal lines in unfinished areas: Wye fitting with cast brass plugs, threaded.

E. At base of vertical lines in unfinished areas and hard piped downspouts. Wye fitting with cast brass plugs, threaded.

F. Cleanouts shall be as follows:

1. Vertical Lines Concealed: Zurn Z1446 or equal.
2. Vertical Lines Exposed: Zurn Z1445-BP or equal, with bronze plug.
3. Horizontal Lines Exposed and/or Above Accessible Ceilings: Zurn Z1440-A-BP or equal, raised head and bronze plug.
4. Horizontal Lines Concealed Under Floors with Tile, Vinyl, Terrazzo and/or Concrete Finish: Zurn ZB1400 or equal, polished bronze top.

G. Cleanouts to Grade (exterior cleanout): Zurn Z1449-BP or equal, cast iron floor cleanout with round heavy duty bronze cover. Locate cleanout set in concrete yard box with cast iron cover marked “sewer”, Brooks 3CI, Christy or equal large enough for two-way clean out assemblies.

## 2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Per roof manufacturer’s recommendations.

## 2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. ProSet Systems Inc.
    b. Or equal.

2. Standard: UL 1479 assembly of sleeve-and-stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

## 2.5 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 with increaser fitting of size indicated.

B. Deep-Seal Traps (DST-):

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.

## PART 3 - EXECUTION

### 3.1 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. The top and faceplate of all cleanouts indoors shall be cleaned and polished prior to final inspection by the Architect.

E. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

1. Comply with requirements in Section 078413 "Penetration Firestopping."

F. Assemble open drain fittings and install with top of hub 2 inches above floor.

G. Install deep-seal traps on floor drains and other waste outlets, if indicated.

H. 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.

I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

J. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

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.

## 3.2 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.

## 3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

B. 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 230553 Mechanical Identification.

## 3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 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

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Plumbing fixtures and trim.
2. Accessories.

### 1.3 REFERENCE STANDARDS

A. As specified in Section 230010 “Mechanical General Provisions.”

### 1.4 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. “R” means required.
2. “R2” means required only for products and equipment differing for the specified manufacturer and model and for “or equals” where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Plumbing fixtures | R | | | R |
| Trim | R | | | |
| Supports | R | | | R |
| Accessories | R | | | |

### 1.5 QUALITY ASSURANCE

A. As specified in Section 230010 “Mechanical General Provisions.”

B. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act".

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Stainless-Steel Fixtures Other Than Service Sinks: ASME A112.19.3M.

H. Comply with the following applicable standards and other requirements specified for sink faucets:

1. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
2. Faucet Hose: ASTM D 3901.
3. Faucets: ASME A112.18.1M.
4. NSF Materials: NSF 61.
5. Pipe Threads: ASME B1.20.1.
6. Supply and Drain Fittings: ASME A112.18.1M.

I. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Pipe Threads: ASME B1.20.1.
2. Supply and Drain Protective Shielding Guards: ICC A117.1.

## 1.6 COORDINATION

A. Coordinate roughing-in and final plumbing fixture locations and verify that fixtures can be installed to comply with original design and referenced standards.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Provide two service kits for each type of faucet, flush valve, shower/tub valve and all other trim/accessories having serviceable parts.

## PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Provide fixtures and trim complete for proper installation as described in the manufacturer's catalog with the modifications as shown on Plumbing Fixture Schedule in the plans or specifications.
2. All fixtures, specified to be of vitreous ware, shall be of a quality known commercially as "twice fired" vitreous chinaware of the best quality, nonabsorbent, burned so that the whole mass is thoroughly fused and vitrified producing a material white in color, which when fractured will show a homogeneous mass, close-grained and free from pores. The glazed and vitreous china fixtures shall be white, thoroughly fused, and united to the body, without discoloration, chips, or flaws and shall be free from cracks. Warped or otherwise imperfect fixtures will not be acceptable.
3. Factory grind back and bases of fixtures smooth.
4. Enamelware to be white cast iron with acid-resisting enamel.
5. Unless otherwise specified, water closets to have a waste passage to pass a 2-1/2-inch ball minimum. Bolt water closets to flanges with a 1-inch, thick rubber foam gasket.
6. Fixture trim and exposed metal items shall be polished chrome-plated unless otherwise noted, and pipes passing through walls shall have polished chrome-plated escutcheon plates. All stainless steel shall be satin brushed (US32D) finish unless noted otherwise.
7. Fixtures shall be free from imperfections, true as to line, angles, curves, and color; smooth, watertight, and practically noiseless in operation.
8. Exposed Pipe, Trim Including Fittings, Traps, Escutcheons, Valves, Valve Handles, and Accessories: Above and Below Fixtures:

    a. Polished chrome plated CP brass.
    b. Setscrew cast brass escutcheons for piping.
    c. Covering tubes not permitted.
    d. Provide Hudee stainless steel rims, as applicable, for non-self-rimming counter mounted fixtures.

9. Supply Fixtures With:

    a. Renewable seats or replaceable internal units.
    b. Compositional washers.

2.2 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models are acceptable.

1. Stainless steel sinks:

a. American Standard.
b. Just.
c. Elkay.
d. Kohler.
e. Or equal.

2. Sink and lavatory trim:

a. Zurn.
b. Kohler.
c. Delta.
d. Or equal.

2.3 SINKS

A. See Construction Drawings for basis of design sinks.

1. Sink: 18-gauge, type 302 stainless steel.
2. Faucet: Manually operated, polished chrome plated, brass deck faucet, 5-3/8-inch centerline rigid or swing gooseneck spout, 4-inch, color coded metal wrist blade handles, 2.2 gpm
3. Strainer: Type 304 stainless steel body and removable conical basket strainer with metal stem and rubber stopper. Chrome plated brass tailpiece, 1-1/2 x 4-inch.
4. Stops and supplies: Two chrome plated, solid brass angle stops with round handles, two flexible chrome plated copper lavatory risers, with chrome plated, cast brass, flange with setscrew, (length of supply tubes determined by Contractor).
5. Trap: 1-1/2-inch, chrome plated, cast brass, P-trap with cleanout with cast brass escutcheon with setscrew.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.

B. Examine walls and floors for suitable conditions where water closets will be installed.

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

## 3.2 APPLICATIONS

A. Include supports for plumbing fixtures according to the following:

1. Heavy-Duty, Floor Mounted Chair Carriers: For all wall mounted plumbing fixtures.

B. Include fitting insulation kits for accessible fixtures according to the following:

1. Lavatories: Cover Hot-and cold-water supplies, stops and handles, drain, trap, and waste to wall.
2. Fixtures with Offset Drain: Cover hot-and cold-water supplies, offset drain, trap, and waste to wall.
3. Other Fixtures: Cover exposed fittings below fixture.

## 3.3 FIXTURE INSTALLATION

A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.

C. Install counter-mounting fixtures in and attached to casework.

D. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

E. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

F. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

G. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

H. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

I. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

J. Install traps on fixture outlets.

K. Install escutcheons at piping wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Heavy-duty type escutcheons, with setscrews shall be utilized in exposed applications under wall mounted lavatories and sinks and on exposed piping applications on tank type water closet stops and on exposed piping to flush valves, etc. Light duty slip-on type may be utilized in concealed installations within cabinets. Use deep-pattern escutcheons if required to conceal protruding fittings.

L. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Grout excessive gaps as required. Match sealant and grout color to fixture color.

M. Items supplied by others as denoted are to be furnished complete with stops, risers, faucets, strainers, tailpiece, and traps. The intent is that this Contractor shall provide all "rough-in" through face of wall and shall connect equipment provided by others, except where otherwise noted.

## 3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water supplies from water distribution piping to fixtures.

C. Connect drain piping from fixtures to drainage piping.

D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

## 3.5 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.6 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets, and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

3.7 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

3.8 PROTECTION

A. Provide protective covering for installed fixtures and fittings throughout construction.

B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

C. Replace any fixtures or equipment broken, cracked, discolored, pitted, or otherwise imperfect.

3.9 OPERATIONAL TESTS

A. Pour at least five (5) gallons of water into every floor drain to test for pipe stoppage. Remedy all stoppage.

END OF SECTION

SECTION 23 00 10 – MECHANICAL GENERAL PROVISIONS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 DIVISION OF WORK

A. This section delineates the division of work between Divisions.

B. Consult all other Sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation. This section is provided to assist the Contractor in coordination of work scope but shall not be construed to limit Contractor's scope of work encompassed by the contract documents.

C. Coordination with other Trades: The following table is intended to assist the Contractors in coordinating the scope of work between Division 23 (Indicated as 23 in table), Section 230900 Energy Management & Control System (indicated as 23C), and other Divisions as indicated. However, the General Contractor is ultimately responsible for coordination among his subcontractors regardless of what is listed in this Section.

| INTERFACE/RESPONSIBILITY MATRIX | | | | | | |
|---|---|---|---|---|---|---|
| System | | Division under which the following is specified | | | | Remarks |
| | | Equipment | Installation | Power Wiring [1] | Control & Interlock Wiring [1] | |
| FIRE SPRINKLER SYSTEM | | | | | | |
| | Modify existing fire protection system as required to meet all applicable codes | 21 | 21 | 26 | 26 | |
| | Flow switches | 21 | 21 | 26 | 26 | |
| | Valve monitors | 21 | 21 | 26 | 26 | |
| | Sprinkler system specialties (tamper switches, pressure switches, etc.) | 21 | 21 | 26 | 26 | |
| FIRE & LIFE SAFETY SYSTEMS | | | | | | |
| | Fire alarm and smoke control systems | 26 | 26 | 26 | 26 | |
| | Duct mounted & in-direct mounted smoke detectors | 26 | 21 | 26 | 26/ 21C | [2] |

| INTERFACE/RESPONSIBILITY MATRIX | | | | | | |
|---|---|---|---|---|---|---|
| System | | Division under which the following is specified | | | | Remarks |
| | | Equipment | Installation | Power Wiring [1] | Control & Interlock Wiring [1] | |
| | Other smoke detectors | 26 | 26 | 26 | 26 | |
| MECHANICAL EQUIPMENT | | | | | | |
| | Water source heat pumps | 23 | 23 | 26 | 23C | [4] |
| | Fans | 23 | 23 | 26 | 23C | |
| | Dehumidifier | 23 | 23 | 26 | 23 | |
| | Motors, 3 phase | 23 | 23 | 26 | 23C | |
| | Motor starters, 3 phase | 23 | 23 | 26 | 23C | |
| | Motors, 1 phase | 23 | 23 | 26 | 23C | |
| | Other powered equipment | 23 | 23 | 26 | 23C | |
| | Disconnects | 26/23 | 26/23 | 26 | 26 | [5] |
| | Water treatment systems (closed systems) | 23 | 23 | 26 | 23C | |
| ENERGY MANAGEMENT & CONTROL SYSTEM | | | | | | |
| | Central control workstations & servers | 23C | 23C | 26 | 23C | |
| | Control system network backbone | 23C | 23C | 23C | 23C | |
| | Control panels | 23C | 23C | 23C | 23C | [6] |
| | Control devices | 23C | 23C | 23C | 23C | |
| | Network IT WAN/LAN drop | - | 23C | 23C | 23C | [7] |
| | Lighting occupancy sensors | 26 | 26 | 26 | 26 | |
| | Daylighting sensors and controls | 26 | 26 | 26 | 26 | |
| PLUMBING SYSTEMS | | | | | | |
| | DHW heater venting and combustion air | 23 | 23 | - | - | |
| | Condensate drains including traps, primers | 22 | 22 | - | - | [7] |
| | Condensate pumps | 22 | 22 | 22 | - | |
| HVAC HYDRONIC SYSTEMS | | | | | | |
| | Pipe gauges, thermometers, test plugs | 23 | 23 | - | - | |
| | Relief valve vent piping, equipment drain piping, etc. from equipment to floor drains/sinks | 23 | 23 | - | - | |
| | Automatic isolation and control valves | 23C | 23 | 23C | 23C | |
| | Sensor wells, meters and other pipe-mounted control devices | 23C | 23 | 23C | 23C | |
| | Test plugs | 23 | 23 | | | [8] |
| HVAC SHEET METAL | | | | | | |
| | Duct mounted sensors | 23C | 23 | 23C | 23C | |
| | Filter gauges | 23C | 23C | - | - | |
| | Control dampers | 23 | 23 | 23C | 23C | [9] |
| | Control damper actuators | 23C | 23C | 23C | 23C | [9],[10] |

| INTERFACE/RESPONSIBILITY MATRIX | | | | | | |
|---|---|---|---|---|---|---|
| System | | Division under which the following is specified | | | | Remarks |
| | | Equipment | Installation | Power Wiring [1] | Control & Interlock Wiring [1] | |
| MISCELLANEOUS | | | | | | |
| | Cutting and Patching | 22/23 | 22/23 | - | - | |
| | Thermal and acoustical insulation in and on partitions and ceilings | 7 | 7 | - | - | |
| | Louvers | 23 | 8 | - | - | |
| | Combination louver/damper | 23 | 23 | 23C | 23C | |
| | Concrete housekeeping pads, curbs, pedestals and inertia base fill etc. for equipment | 3 | 3 | - | - | [11] |
| | Equipment, ductwork, and piping steel supports and frames | 23 | 23 | - | - | |
| | Painting of exposed piping, HVAC equipment, etc. | 9 | 9 | - | - | |
| | Fire-stopping around pipe and duct penetrations in floor and walls | 22/23 | 22/23 | - | - | |
| | Framing of walls and ceilings to accept air outlets, fire dampers, etc. | 9 | 9 | - | - | [12] |
| | Ceiling and wall access doors | 22/23 | 8 | - | - | [13] |

NUMBERED REMARKS:

[1] Wiring includes raceway, fittings, wire, boxes and related items, all voltages

[2] Wiring of interlock of duct smoke detectors to shut off supply fans upon detection of smoke is specified under Section 230900 Energy Management & Control System. All other smoke control/fire alarm related control wiring is specified under Division 26 Electrical.

[3] Not used.

[4] Factory installed starters and variable speed drives are specified under Division 23 HVAC. Prewired control panel is specified under Division 23 HVAC, single point power connection (unless otherwise noted on drawings) specified by Division 23 HVAC. Packaged mechanical equipment specified with BACnet communication cards/gateways shall be provided by Division 23 HVAC. Water source heat pump vendor to provide all necessary technical assistance to Division 23C Contractor in mapping across equipment points to the EMCS.

[5] Disconnects are specified under Division 23 HVAC where specifically called for in equipment schedules or specifications to be factory installed with equipment. Otherwise, all disconnects are specified under Division 26 Electrical.

[6] Power to all EMCS control panels is specified under Section 230900 Energy Management & Control Systems, coordinate with Division 26 contractor for available circuits.

[7] Coordinate piping from condensate drains and pans to the sewer system including trap and final connections is specified under Division 22 Plumbing. Piping from auxiliary drain pans, where provided at air

| INTERFACE/RESPONSIBILITY MATRIX | | | | | |
|---|---|---|---|---|---|
| System | Division under which the following is specified | | | | Remarks |
| | Equipment | Installation | Power Wiring [1] | Control & Interlock Wiring [1] | |
| handling equipment in furred spaces is specified under Division 23 HVAC.<br>[8] Test plugs mounted adjacent to all temperature well (for calibration) specified under Division 23<br>[9] Duct access doors required for access to control devices where required specified under Division 23 HVAC.<br>[10] Actuators for motorized dampers supplied with fans or hood, where scheduled on HVAC drawings are specified under Division 23 HVAC, mounted but not wired. Wiring specified under Section 230900 Energy Management and Control System.<br>[11] Shop drawings showing dimensions of all curbs, bases, etc. specified under Division 23 HVAC.<br>[12] Additional T-bar or spline and cut ceiling tile as required to accept air outlets is specified under Division 9.<br>[13] Dimensioning of access doors to mechanical equipment and coordination with Architect and Division 8 specified under Division 22/23. | | | | | |

D. HVAC/Electrical Design Coordination

1. The power ratings of motors and other HVAC equipment and the electrical characteristics of electrical systems serving them, as specified herein and indicated on the Drawings, have been established as minimums which will allow that equipment to satisfactorily function while producing the required capacities. These power ratings include a safety factor deemed appropriate to accommodate common differences between design parameters and field construction practices. Under no circumstances shall equipment with power ratings less than those indicated on the Drawings or specified herein be provided.
2. Reasonable efforts have been made to coordinate the electrical requirements of the HVAC equipment with the electrical systems serving that equipment. Differences among manufacturers of HVAC equipment make it impossible to produce a single electrical design which will satisfy the varying electrical requirements of those manufacturers. Consequently, the Contractor shall coordinate the electrical requirements of the HVAC equipment actually furnished on this Project and provide the electrical systems required by that equipment. This coordination effort shall be completed prior to the installation of either the HVAC equipment or the electrical systems serving that equipment. Electrical system revisions required to coordinate with the HVAC equipment actually furnished shall be provided at no additional cost to the Owner.

E. Related Work Specified Elsewhere

1. Utilities five feet beyond building line unless noted otherwise: See Division 33 Utilities
2. Structural steel (except as specified herein): See Division 05 Metals.

3. Grates and railings protecting mechanical shaft and other floor openings: see Division 05 Metals.
4. Miscellaneous lumber and framing work, such as for framing, soffits and support of mechanical materials and equipment. See Division 06 Wood, Plastics, and Composites.
5. Undercutting of doors and door louvers: See Division 08 Openings.
6. Painting (except as specifically indicated): See Division 09 Finishes
7. Fire resistant enclosures around ducts and at fire dampers such as at the bottoms of shafts. See Division 09 Finishes.
8. Electric power, interlock, and control wiring, except as specified herein.
9. Installation of starters, contactors, thermal overload switches, and remote push buttons, except as specified herein.
10. Fire alarm initiating devices, control modules, and monitoring modules.
11. Curbs, flashing, and pitch pockets for equipment on roof, except as specified herein.
12. Manhole construction.
13. Louvers and screens, except as specified herein.
14. Concrete equipment pads.

1.3 REFERENCE STANDARDS

A. Reference to codes, standards, specifications and recommendation of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.

B. Work shall be performed in accordance with all applicable requirements of the latest edition of all governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not.

C. Requirements of Regulatory Agencies

1. In accordance with the requirement of Division 1 General Requirements.
2. Nothing in contract documents shall be construed to permit work not conforming to current and applicable laws, ordinances, rules, and regulations.
3. Where contract documents exceed requirements of applicable laws, ordinances, rules, and regulations, comply with documents establishing the more stringent requirement.
4. It is not the intent of contract documents to repeat requirements of codes except where necessary for completeness or clarity.
5. Comply with the Safety Orders issued by OSHA and any other safety, health or environmental regulations of the State of Mississippi and any districts having jurisdictional authority. Where an omission or conflict appears between OSHA requirements and the Drawings and Specifications, OSHA requirements shall take precedence.
6. Applicable codes as listed below, in addition to others specified in individual sections.

    a. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) – Standard 90.1-2010 “Energy Standard for Buildings Except Low-Rise Residential Buildings”.
    b. International Building Code (IPC) – 2012.
    c. International Mechanical Code (IMC) – 2012.

d. International Plumbing Code (IPC) - 2012.
e. NFPA 1 – 2012, Fire Code
f. NFPA 70 - 2008, National Electric Code
g. NFPA 90A - 2009, Installation of Air Conditioning and Ventilating Systems

D. Published specifications, standards, tests or recommended method of trade, industry or governmental organizations as listed below apply to all work in Division 23 HVAC, in addition to other standards which may be specified in individual sections.

E. All base material shall meet ASTM and ANSI standards.

F. All Gas Fired Devices: Comply with standards and bear label of AGA.

G. All Pressure Vessels, Relief Valves, Safety Relief Valves and Safety Valves: Comply with standards, ASME stamped.

H. All Electrical Devices and Wiring

1. Conform to standards of NEC
2. All devices UL or ETL listed and identified

I. Guidelines and Standards: The latest edition of guidelines and standards published by the following govern the Mechanical Systems and associated support system design. The systems shall be designed to meet or exceed these guidelines and standards.

| | |
|---|---|
| AABC | Associated Air Balance Council |
| ADC | Air Diffuser Balance Council |
| AGA | American Gas Association |
| AMCA | Air Movement and Control Association, Inc. |
| ANSI | American National Standards Institute |
| ARI | Air Conditioning and Refrigeration Institute |
| ASC | Adhesive and Sealant Council |
| ASHRAE | American Society of Heating, Refrigeration and Air Conditioning Engineers |
| ASME | American Society of Mechanical Engineers |
| ASSE | American Society of Sanitary Engineers |
| ASTM | American Society for Testing and Materials |
| AWWA | American Water Works Association |
| AWS | American Welding Society |
| ETL | Interlek Semko (Formerly Electrical Testing Laboratories) |
| HI | Hydraulic Institute |
| ICBO | International Conference of Building Officials |
| IEEE | Institute of Electrical and Electronic Engineers |
| NBS | National Bureau of Standards |
| NEBB | National Environmental Balancing Bureau |
| NEC | National Electric Code |
| NEMA | National Electrical Manufacturer’s Association |
| NFPA | National Fire Protection Association |
| OSHA | Occupational Safety and Health Act |
| PDI | Plumbing and Drainage Institute |
| SMACNA | Sheet Metal and Air Conditioning Contractors National Association, Inc. |
| UL | Underwriter’s Laboratories, Inc. |

1.4 QUALITY ASSURANCE

A. Supply all equipment and accessories in compliance with the applicable standards listed in herein and with all applicable national, state, and local codes.

B. All equipment and accessories shall be new, and the product of a manufacturer regularly engaged in its manufacturer.

C. All items of a given type shall be the products of same manufacturer.

D. Workmanship, material, and equipment shall be in accordance with Specifications and Drawings and in some instances the requirements exceed those required by codes and standards. Where not exceeded, the codes and standards shall be considered as absolute minimum requirements.

1.5 SUBMITTALS

A. No work may begin on any segment of this Project until the related submittals have been reviewed for conformance with the design intent and the Contractor has responded to all comments to the satisfaction of the Owner.

B. Submit drawings, product data, samples and certificates of compliance required as hereinafter specified. See also Division 01 – General Requirements.

C. Submit no later than 35-days after signing of Contract, or as otherwise indicated by Architect. Submit a schedule indicating the proposed submission date of each submittal specified herein. Schedule shall anticipate the submittal review time, the possible need for resubmittals, and the time required for fabrication, shipping, and integration into the construction sequence. Architect will advise of any conflicts in reviewing submittals that the proposed schedule presents.

1. Complete schedule of submittals for equipment and layout shop drawings. Allow 15-working days for review unless Architect agrees to accelerated schedule.
2. List of all proposed substitutions: See requirements herein.
3. Designate in schedule dates for submission and dates that reviewed shop drawings, product data and samples will be needed.
4. Provide submittals promptly in accordance with schedule and in such sequence as to cause no delay in work or in work of any other division.

D. Submit drawings, product data, samples and certificates of compliance required hereinafter specified.

1. See also Division 01 General Requirements.
2. Provide submittals promptly in accordance with schedule and in such sequence as to cause no delay in work or in work of any other division.
3. Submittals for each specification section shall be submitted in a single package. However, it is not required (nor desired) for all products to be submitted concurrently. Rather, submittals may be staggered based on schedule and required equipment release dates.
4. Allow 15-working days for review unless the Architect agrees to accelerated schedule.
5. For substitutions, list any features or characteristics that are not strictly in compliance with specifications. If none are listed with

the submittal, Contractor is guaranteeing that substituted product is functionally equivalent to the specified product in accordance with requirements herein.

6. Submittal reviews by the Architect are intended to assist the Contractor in complying with the design intent and requirements of the drawings and specifications. Reviews do not relieve the Contractor from compliance with these requirements and comments or lack thereof does not constitute approval of changes in these requirements.

E. Submission and Resubmission Procedure.

1. Each submittal cover sheet shall contain the Contractor's review statement. The statement shall be worded as follows:

   a. It is hereby certified that the information included in this submittal and approved/proposed to be incorporated into this project (include official project name on Contract Drawings) is in compliance with the Contract Drawings and specifications, the electrical requirements have been coordinated with the Electrical Sub-Contractor, can be installed in the allocated spaces with adequate service space, and is approved for use and is submitted for Architect's review.

   Authorized Reviewer: _____ Date: _____

2. Each submittal shall have a unique serial number that includes the associated specification section followed by a number for each sub-part of the submittal for that specification section, such as "SUBMITTAL 23 xx xx-01".
3. Each resubmittal shall have the original unique serial number plus revision number such as "SUBMITTAL 23 xx xx-01 REVISION 1".
4. Submit in format specified below. Submissions made in wrong format will be returned without action.

   a. Product Submittals: One copy in word-searchable electronic format per requirements herein. Submit each specification section in a separate file named with unique name and number described above.
   b. Shop Drawings:

      1) One copy in electronic format .dwg, .dwf, or .pdf
      2) Two and only two copies on paper; any additional copies will not be returned without review

   c. Samples: As indicated in each specification section.

5. Architect will return a memo or mark-up of submittal with comments and connections noted where required.
6. Make corrections

   a. Revise initial submittal to resolve review comments and corrections.
   b. Indicate any changes that have been made other than those requested.
   c. Clearly identify resubmittal by original submittal number and revision number.

7. Resubmit revised submittals until no exceptions are taken.
8. Once submittals are accepted and stamped with no exceptions taken, provide:

    a. Complete submittal of all accepted products in a single electronic file for each specification section.
    b. Photocopies for coordination with other trades, if and as required by the Contractor or Architect. Photocopies will serve as submittal for record and coordination.

F. Product Data Submittals

1. Contents.

    a. Manufacturer's name and model number.
    b. All information required to completely describe materials and equipment and to indicate compliance with drawings and specifications, including, but not limited to:

        1) Schedule when more than one of each item is covered by submittal.
        2) Physical data, as applicable.

            a) Dimensions.
            b) Weights.
            c) Finishes and colors.
            d) Dimensional shop drawings.

        3) Performance data, as applicable.

            a) Rated capacities.
            b) Performance curve.
            c) Operating temperature and pressure.
            d) Efficiency.

        4) Flow and wiring diagrams as applicable.
        5) Description of system operation.

    c. All other pertinent information requested in individual sections.

2. Format.

    a. See Division 01 – General Requirements.
    b. Identify clearly if submittal is substitution: See requirements herein.
    c. Reference specification Division, Section, Title, Paragraph and Page number or drawing number as applicable
    d. Use same nomenclature, legend, symbols, and abbreviations on submittal material as used in contract documents.

## 1.6 COORDINATION DRAWINGS (LAYOUT SHOP DRAWINGS)

A. Coordination drawings.

1. Drawings shall be developed in format compatible with AutoCAD version 2010 or later.

2. Shop fabrication, coordination, and installation drawings by the Contractor, are for the Contractor's use and shall be the Contractor's responsibility. These Drawings indicate where the Contractor intends to install the material and equipment as required by the Contract Documents. Submit coordination drawings in a timely manner so that they can be utilized by all trades. Use of contract documents or electronic files of contract documents for shop drawings is not sufficient.
3. Clearly indicate deviations from Contract Drawings.
4. Review is not intended to verify dimensions or quantities, or to coordinate items shown on these Drawings. Review is for general conformance with design concept of the Project and general compliance with the information given in the Contract Documents. Contractor is responsible for dimensions, which shall be confirmed and correlated at the Jobsite, for fabrication processes and techniques or construction, for coordination of Work with that of all other trades and the satisfactory performance of Work.
5. Prepare and submit layout drawings, sections, and details for following areas, minimum 1/4-inch scale:

    a. Mechanical equipment rooms.
    b. Equipment mezzanines.
    c. Congested areas (ceiling plenums, furring's, shafts, etc.)

6. Prepare layout shop drawings for all other areas; minimum 1/8-inch scale.
7. Layout drawings, as a requirement of Division 23 HVAC, shall indicate, superimposed, Work of all Sections involved in congested area, including ductwork, piping, electrical work, ceiling work, etc. Include all mechanical rooms. Identification of space problems without solutions is not acceptable.
8. Individual coordinated trade layout drawings are to be prepared for all deviations from design documents.
9. Contractor is to assure that each trade has coordinated work with other trades, prior to submittal.

    a. Include stamp on each submittal indicating that layout shop drawing has been coordinated:
    b. No layout shop drawing will be reviewed without stamped and signed coordinated assurance by Contractor.

10. All changes shall be clearly marked on each submitted layout drawing.
11. Drawings shall show work of all trades including but not limited to:

    a. Ductwork.
    b. Piping: All Trades, including Fire Sprinklers and electrical installations.
    c. Mechanical Equipment.
    d. Electrical Equipment.
    e. Main Electrical conduits and bus ducts.
    f. Equipment supports and suspension devices.
    g. Structural and architectural constraints (structural steel, columns, ceilings, walls, floors, etc.).
    h. Show location of:

        1) Valves: manual and automatic.
        2) Air distribution devices (including sidewall devices with dimensions from finish floor elevation).

3) Exterior wall penetrations (include dimensions from reference elevation).
4) Piping specialties.
5) Dampers: fire/smoke, automatic and manual volume, etc.
6) Access doors.
7) Control and electrical panels.
8) Others as required for clear coordination.

12. Drawings shall indicate coordination with work specified in other Divisions which must be coordinated with work specified under Divisions 21, 22 and 23 Mechanical, including, but not limited to:

a. Irrigation equipment and piping.
b. Elevator equipment.
c. Building vacuum cleaning systems.
d. Pneumatic tube systems.
e. Cable trays.
f. Computer equipment.
g. Others as required.

13. Equipment, control devices, dampers, valves, etc. requiring periodic maintenance or adjustment shall be included in coordination drawings. Specifically, the contractor shall verify and coordinate that access is provided to these components via lay-in ceiling or adequately sized access doors in walls, floors, ceilings, etc.
14. Submission of drawings.

a. Submit to other trades for review of space allocated to all trades.
b. Revise drawings to compensate for requirements of existing conditions and conditions created by other trades.
c. Ensure that each trade has coordinated work with other trades.
d. Submit with stamps of General and all other applicable Contractors, initialed and signed certifying.

1) Review of submittal.
2) Verification of products, field measurements and field construction criteria.
3) Coordination of information in submittal with requirements of work of this Division and other divisions of Contract Documents.

e. No layout shop drawing will be reviewed without stamped and signed coordination assurance by the Contractor.

## 1.7 COMPLETION REQUIREMENTS

A. Procedure.

1. Until the documents required in this section are submitted and approved, the system will not be considered “accepted”.
2. Before requesting acceptance of work, submit one set of Completion Documents for review and approval of Architect.
3. After review, furnish quantity of sets indicated below to Owner.
4. Format:

a. See herein for required format of Completion Documents.

b. Paper copies; assemble in chronological order following alpha-numeric system used in specification, in heavy three-ring binder.
c. Where electronic copies are called for herein, comply with the following:

1) Provide in word-searchable electronic format; acceptable formats are MS Word, Adobe Acrobat (pdf) and HTML; submit other formats for review and approval prior to submission; scanned paper documents not acceptable.
2) For submittals, provide separate file for each type of equipment.
3) For Test & Balance report, provide separate files for each air handling system.
4) Record drawings shall be in original format.

B. Operating and Maintenance (O&M) Manual.

1. See O&M Manual requirement herein

C. Record Drawings.

1. Keep up-to-date during progress of job one set of Mechanical Drawings indicating the Record installation. In addition to changes made during course of Work, show following by dimension from readily obtained base lines.

a. Fully illustrate all revisions made by all crafts in course of work.
b. Include all field changes, adjustments, variances, substitutions, and deletions, including all Change Orders.
c. Exact location, type and function of concealed valves, dampers, controllers, piping, air vents and piping drains.
d. Exact size, invert elevations and location of underground and under floor piping and ducts.

1) Progress drawing set shall be available for inspection by Architect weekly.
2) Update engineering design drawings and shop drawings to reflect revisions and additional data listed above at completion of Project.

e. Original engineering design drawings will be provided to Contactor in electronic format compatible with AutoCAD version 2010 or later.
f. Both shop and engineering design drawings shall be in format compatible with AutoCAD version 2010 or later.
g. Drawings required to be updated if revisions were made.

1) Floor plans.
2) Shop drawings required herein.
3) Sections.
4) Riser diagrams.

D. Test and Balance Reports.

1. See Section 230593 – Testing, Adjusting, and Balancing for HVAC.

E. Training Materials.

1. See Training Materials requirements herein.

F. Miscellaneous Certificates.

1. Pressure and Leakage Test documentation/certificates.
2. Training/Instruction completion certificates.
3. Fire Marshal and Fire Department approvals of system, as required.
4. Final inspection certificate signed by governing authorities.
5. Warranty period, including start and end period.
6. Field test report, including as applicable.
7. Start-up documents with date and name of technician.
8. Piping pressure tests.
9. Flex coupled pump alignment verification.
10. Duct leakage and pressure tests.
11. Drain pan drainage tests.
12. Letters from manufacturers certifying their supervision of equipment installation and start-up procedures.
13. Machinery vibration test reports.
14. Certificates of sterilization/chlorination of plumbing systems.
15. Others as specified herein and in other Division 23 – Mechanical sections.

G. Format of Completion Documents.

1. Provide the type and quantity of media listed in table below.
2. Optical media shall be readable on a personal computer.
3. Where indicated in table, the electronic files shall be stored on the EMCS systems' Operator Workstation and hyperlinked to the front-end DDC controls graphics so operators can get the details of a certain device or balance reports by clicking on the link: See Section 230900 – Energy Management & Control Systems.

| | Document | Paper (Binder or bound) | Electronic | |
|---|---|---|---|---|
| | | | Read only optical disk | Loaded Onto Operator Workstation |
| 1 | O&M Manuals | 3 | 1 | 1 |
| 2 | Record Drawings | 2 Full size<br>2 Half size | 1 | 1 |
| 3 | Original issue EMCS software & manuals | 1 | 1 | 1 |
| 4 | Control sequences | 1 | 1 | 1 |
| 5 | Test and Balance Report | 5 | 1 | 1 |
| 6 | Miscellaneous Certificates | 1 | 1 | 1 |
| 7 | Warranty documents | 1 | 1 | 1 |
| 8 | Training materials | 1 per trainee | 1 | 1 |

1.8 SUBSTITUTIONS AND PRODUCT OPTIONS

A. For specific substitution requirements, See Division 00, and Division 01.

B. Where equipment and materials are shown on the drawings and/or specified hereinafter by a manufacturer's name and/or model number, it is the intent of these specifications to set minimum definite standards for equipment and materials to be used on the project. It is not the intent of these specifications to preclude the use of materials and equipment of similar design and quality to manufacturer's name specified. If the Contractor desires to substitute materials and equipment, he shall obtain written approval through the materials submittals process of all such substitutions before such substitutions are made. Unauthorized substitutions of materials and equipment may be ordered removed from the project without further grounds. The Architect will not approve any substitutions for specified materials and equipment unless such substitutions are requested by the Contractor.

C. The products of particular manufacturers have been used as the basis of design in preparation of these documents. It shall be the responsibility of this Contractor to determine if the submitted materials and equipment will fit into the space allotted with all required clearances as the materials and equipment utilized as the basis of design. Furthermore, the Contractor and shall verify and maintain adequate access to equipment, valves, filters, lubrication outlets, etc. Any changes to the building or system design necessary shall be arranged for in writing before the materials and equipment is ordered. All costs involved in making such changes shall be borne by the Contractor. If such changes are deemed inadvisable by the Architect, the Contractor shall install items specified even though materials and equipment had been previously approved. Architect's approval of materials and equipment other than the basis of design is for performance only.

D. Contractor shall consider the following parameters (at a minimum) when considering materials and equipment substitutions:

1. Capacities: The capacities included in the Contract Documents are absolute minimum and the substitution shall have equal or greater capacities.
2. Physical size limitations: Substitutes shall fit in the allotted space and shall have the manufacturer's minimum clearances.
3. Installation and operation weights.
4. Structural properties.
5. Noise levels.
6. Vibration.
7. Interchangeability.
8. Accessibility for maintenance, operation, and replacement.
9. Compatibility with other materials and assemblies.
10. Equal quality and style.

## 1.9 DESCRIPTION OF BID DOCUMENTS

A. The Contractor shall be responsible for becoming thoroughly acquainted with all Contract Document contents that affect his work under this contract. Work required under this section includes, but is not limited to, all material, equipment transportation, services and labor required to complete the entire mechanical system as required by the Contract Documents.

B. The Specifications and the associated Drawings are complimentary, and any portion of the work described in one shall be provided as if described in both.

C. Specifications.

1. Specifications, in general, describe quality and character of materials and equipment.
2. Specifications are of simplified form and include incomplete sentences.
3. Words or phrases such as "The Contractor shall," "shall be," "furnish," "provide," "a," "an," "the," and "all" have often been omitted from specifications for brevity.

D. Drawings.

1. Drawings are diagrammatic in nature and, unless explicitly dimensioned, indicate approximate locations of apparatus, equipment, ductwork, and piping. Changes in the location, and offsets, of same which are not shown on the Drawings but are necessary in order to accommodate building conditions, and coordination with the work of other trades, shall be made during the preparation of coordination drawings and prior to initial installation, without additional cost to the Owner. Contractor shall install all system components in such a manner as to conform to the structure, avoid obstructions, preserve headroom, keep openings and passageways clear and maintain required servicing clearances without further instructions or additional cost to the Owner.
2. Scaled and figured dimensions are approximate and are for estimating purposes only. Indicated dimensions are limiting dimensions where noted. Duct and piping elevations are indicated for initial coordination; final requirements shall be determined by the Contractor after final coordination with other trades.
3. Before proceeding with work, check and verify all dimensions in field.
4. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.
5. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom and avoid architectural openings, structural members and work of other trades.
6. It is intended that all mechanical, plumbing and fire protection devices, piping, etc. be located symmetrically with all architectural elements. Refer to Architectural, Structural, Plumbing, Fire Protection, Mechanical and Electrical Specifications and Drawings in completing the required coordination.
7. The Contractor shall fully inform himself regarding any, and all peculiarities and limitations of the spaces available for the installation of all work and materials furnished and installed under this Contract. He shall exercise due and particular caution to determine that all parts of his work are made readily accessible.
8. The Contractor shall study all drawings and specifications to determine any conflict with all applicable ordinances and statutes. Any discrepancies shall be reported to the Owner and any changes shall be shown on the as-built drawings with the additional work performed at no cost to the Owner.
9. The submittal of his bid shall indicate the Contractor has examined the site, drawings and specifications and has included all required allowances in his bid. No allowance shall be made for any error or omission resulting from the Contractor's failure to visit job site and to review drawings and specifications. The Contractor's bid shall include costs for all required drawings and changes as outlined above at no cost to the Owner.
10. Provide access to equipment and apparatus requiring operation, service, or maintenance throughout the life of the system.

E. Do not use equipment exceeding dimensions indicated on drawings or equipment or arrangements that reduce required clearances or exceed specified maximum dimensions.

F. If any part of Specifications or Drawings appears unclear or contradictory, apply to Architect for an interpretation and decision prior to as early as possible.

1. Do not proceed with work without the decision of the Architect.

1.10 DEFINITIONS

A. In addition to those defined in Division 01 – General Requirements, the following additional definitions shall apply. Definitions of term used in Division 23 HVAC may differ from those given in general and supplementary conditions.

B. "Provide": to furnish, supply, install and connect-up complete and ready safe and regular operation of particular work referred to unless specifically noted.

C. "Supply": to purchase, procure, acquire, and deliver complete with related accessories.

D. "Work": includes labor, materials, apparatus, controls, equipment services and all related accessories necessary for the proper and complete installation of complete systems.

E. "Piping": includes pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and all related accessories.

F. "Wiring": includes raceway, fittings, wire, boxes, and all related accessories.

G. "Concealed": not in view, installed in masonry or other construction, within furred spaces, double partitions, hung ceiling, trenches, crawl spaces, or enclosures.

H. "Exposed": in view, not installed underground or "concealed" as defined above. Exposed piping, conduit, or ductwork is that which can be seen when the building is complete without opening or removing access doors or panels or accessible ceiling components.

I. "Control or Actuated Devices": includes automatic sensing and switching devices such as thermostats, pressure, float, flow, electro-pneumatic switches and electrodes controlling operation of equipment.

J. "Indicated," "shown" or "noted": as indicated, shown, or noted on drawings or specifications.

K. "Reviewed," "approved," or "directed", as reviewed, approved or directed by or to Owner.

L. "Motor Controllers": starter, variable speed drives and other devices controlling the operation of motors.

1.11 PROJECT CONDITIONS

A. Examine site related work and surfaces before starting work of any Section.

1. In case of conflict, the most stringent takes precedence.
2. For purposes of clarity and legibility, Drawings are essentially diagrammatic to extent that many offsets, bends, unions, special fittings, exact locations of items are not indicated, unless specifically dimensioned. Especially note a number of required duct and pipe offsets to coordinate with structure and not shown. Coordinate dimensioned conditions, including invert elevations, with other trades prior to installation by any trade.
3. Exact routing of piping, ductwork, etc. shall be governed by structural conditions and other obstructions. Not all offsets in ductwork or piping are shown on the Drawings. Determine which item to offset or relocate. Maintain required slope in piping. Make use of data in Contract Documents. In addition, Architect reserves right, at no additional cost to the Owner, to make any reasonable change in location of mechanical items, exposed at ceiling or on walls, to group them into orderly relationships or increase their utility. Verify Owner's requirements in this regard prior to rough-in.
4. Take dimensions, location of doors, partitions, similar physical features from Architectural Drawings. Verify at Site under this Division. Consult Architectural Drawings for exact location of outlets to center with Architectural features, panels, etc., at the appropriate location shown on Mechanical Drawings.
5. Mounting heights of brackets, outlets, etc., as required.
6. Report to Architect, in writing, conditions which will prevent proper provision of this work.
7. Beginning work of any Section without reporting unsuitable conditions to Architect constitutes acceptance of conditions by Contractor.
8. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to the Owner.

B. Coordination.

1. Work out all "tight" conditions involving Work specified under this Division and work in other Divisions in advance of installation, if necessary, and before Work proceeds in these areas, prepare supplementary Drawings under this Division for review showing all Work in congested area. Provide supplementary Drawings, additional Work necessary to overcome congested conditions, at no additional cost to the Owner.
2. Conflicts: Difference or disputes concerning coordination, interference, or extent of Work between sections shall be decided as follows:

    a. Install mechanical and electrical systems in the following order of preference (those trades listed below another must reroute to resolve the conflict):

        1) Drain piping required by code to be sloped.
        2) Supply air and exhaust air ductwork connected to fans.
        3) Electrical conduit 4 inches and larger.
        4) Hydronic piping connected to pumps.
        5) Domestic water piping.
        6) Fire sprinkler piping.
        7) Electrical conduit smaller than 4 inches.

8) Transfer ducts and other ductwork not connected to fans.
9) Control system piping and wiring.

b. Continued disputes shall be decided by Contractor and Contractor's decision, if consistent with Contract Document requirements, shall be final.

3. Supervision: Personally, or through an authorized and competent representative, constantly supervise the work from beginning to completion and, within reason, keep the same foreman and workmen on the Project throughout the Project duration.
4. Provide templates, information, and instructions to other Divisions to properly locate hides and openings to be cut or provided.
5. The drawings govern in matters of quantity, and the specifications govern in matters of quality. In the event of conflict within the drawings involving quantities, or within the specifications involving quantities, or within the specifications involving quality, the greater quantity and higher quality shall apply. Such discrepancies shall be noted and clarified in the Bid. No additional allowances will be made because of errors, ambiguities, or omissions that reasonably should have been discovered during the preparation of the Bid.

C. Equipment Rough-in.

1. Rough-in locations shown on Mechanical Drawings for equipment furnished by the Owner and for equipment furnished under other Divisions are approximate only. Obtain exact rough-in locations from following sources.

a. From Shop Drawings for equipment provided under this contract.
b. From Architect for Owner Furnished-Contractor installed equipment.
c. From existing equipment where such equipment is relocated under this Contract.

2. Verify mechanical characteristics of equipment before starting rough-in. Where conflict exists between equipment and rough-in shown on Drawings obtain clarification from Architect and provide as directed by the Architect at no additional cost to the Owner.
3. Make final connections.

## 1.12 CLEARANCE FROM ELECTRICAL EQUIPMENT

A. Piping, equipment, or ductwork.

1. Prohibited, except as noted in:

a. Electric rooms and closets over equipment, as restricted by NEC.
b. Telephone rooms and closets.
c. Elevator machine rooms.
d. Elevator shafts.
e. Electrical switchboard room.
f. Communications room.

2. Prohibited, except as noted, over or within 5 feet of:

a. Transformers.
b. Substations.

c. Switchboards.
d. Motor control centers.
e. Standby power plant.
f. Bus ducts.
g. Electrical panels.
h. Variable frequency drives.
i. Starters.

B. Drip pans under piping.

1. Where piping is located over any electrical equipment listed above; reroute piping if possible, rather than use drip pan.
2. 28 gage galvanized steel.
3. 18 gage copper.
4. Reinforced and supported.
5. Watertight.
6. With 1-1/4-inch drain outlet piped to floor drain or service sink.

C. Electrical Working Space: Dimensions of the working space shall be a minimum depth of 42" horizontally, the width of the equipment or 30", whichever is greater, and the height of the equipment or 78", whichever is greater. Minimum depth shall be increased to 60" for equipment rated over 600 V.

## 1.13 PRODUCT DELIVERY, HANDLING AND STORAGE

A. See Division 01 – General Requirements (Product Requirements).

B. Deliver equipment in its original package to prevent damage or entrance of foreign matter. Provide materials on factory provided shipping skids and lifting lugs if required for handling. Provide protective coverings during construction.

C. Handle and ship in accordance with manufacturer’s recommendations.

D. Identify materials and equipment delivered to Site to permit check against approved materials list, reviewed with no exceptions taken Shop Drawings.

E. Protect from loss or damage. Replace lost or damaged materials and equipment with new at no additional cost to Owner.

F. Where necessary, ship in crated sections of size to permit passing through available space.

## 1.14 PROJECT MANAGEMENT AND COORDINATION SERVICES

A. See Division 01 – General Requirements.

B. Overview: Provide a project manager/engineer for the duration of the Project to coordinate the Division 23 HVAC work with all other trades. Coordination services, procedures and documentation responsibility shall include, but shall not be limited to the items listed in this section.

C. Review of shop drawings prepared by other subcontractors

1. Obtain copies of all shop drawings for equipment provided by others that require electrical service connections or interface with Division 23 HVAC work.
2. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 23 HVAC contract documents. Document and discrepancy or deviation as follows:

    a. Prepare memo summarizing the discrepancy.
    b. Provide a copy of the specific shop drawing, indicating via cloud, the discrepancy.

3. Prepare and maintain a shop drawing review log indicating the following information.

    a. Shop drawing number and brief description of the system/material.
    b. Date of review.
    c. Indication if follow-up coordination is required.

D. Request for Information (RFI)

1. See Division 1 Request for Information

1.15 REVIEW OF CONSTRUCTION

A. Work may be reviewed at any time by representatives of the Owner and/or Architect.

B. Advise Owner that work is ready for review at the following times.

1. Prior to backfilling buried work.
2. Prior to concealment of work in walls and above ceilings.
3. When all requirements of Contract have been completed.
4. When testing will be performed.

C. Do not backfill or conceal work without Architect’s consent.

D. Maintain on site, one set of Specifications and Drawings for use by Owner and/or Architect.

E. Contactor is responsible for construction methods, sequences, and safety precautions.

1. Include all change orders

1.16 SCHEDULE OF WORK

A. In accordance with Division 01 – General Requirements and as follows:

1. Arrange work to conform to schedule of construction established or required to comply with Contract Documents.
2. In scheduling, anticipate means of installing equipment through available openings in structure.

B. Confirm in writing to Architect, within 35-days of signing of contract, anticipated number of days required to perform test, balance, acceptance

testing and commissioning of mechanical systems. Schedule test balance and acceptance testing of mechanical systems as follows:

1. Submit for review at this time, names and qualifications of test and balancing agencies to be used.
2. Test, Adjusting and Balancing and commissioning must occur after completion of mechanical systems, including all control calibration and adjustment, and requires substantial completion of the building, including closure, ceilings, lighting, partitioning, etc.
3. Allow 21-days after test and balance for system commissioning and life safety testing (where applicable).

1.17 CUTTING AND PATCHING

A. See Division 01 – General Requirements.

1.18 UTILITY CONNECTIONS

A. Utilities include but are not limited to, water, sanitary sewer, storm sewer, natural gas, fire protection water, chilled water, heating water, steam, Energy Management and Control System, etc.

B. Connect to utility company mains as required. Include all meters and other ancillary components required by serving utility company.

C. Connect to on-site piping mains.

D. Contractor shall be responsible for payment of all service charges.

E. Contractor shall be responsible for provisions for temporary utilities.

F. (Others as required).

1.19 WARRANTY

A. In accordance with Division 1 Guarantees, Warranties, Bonds, Service & Maintenance Contracts and as follows.

B. Warranty all materials, equipment, apparatus, and workmanship to be free of defective materials and faulty workmanship for a period of one year from and after date of acceptance of completed contract.

C. Provide new materials, equipment, apparatus, and labor to replace that determined by Architect to be defective or faulty.

D. This guarantee also applies to services including instructions, adjusting, testing, noise, balancing, etc.

E. Furnish Manufacturer’s standard Warranties in excess of one year.

F. Refrigerant compressors to have an additional four-year parts warranty.

G. Nothing herein intends or implies that guarantee shall apply to work which has been abused or neglected by the Owner or the Owner's successor in interest.

1.20 PERMITS

A. Obtain all permits, certificates of inspections, patent rights and licenses that are required for the performing of this work by all laws, ordinances, rules and regulations or orders of any officer and/or body. Provide all notices necessary in connection therewith, and pay all fees relating thereto and all costs and expenses incurred on account thereof. No work shall be covered before inspection by the jurisdiction authorities and observation by the Architect.

1.21 CONTINUITY OF EXISTING SERVICE AND SYSTEMS

A. Schedule work so existing systems will not be interrupted. Obtain approval from the Owner and Architect at least 14 days prior to any utility interruption or connection.

B. Perform work at such time and in such a manner as to cause minimum inconvenience to the Owner and as approved by the Architect. No allowance will be made for lack of knowledge of existing conditions.

C. Existing utility service and systems:

1. Protect existing active utilities.
2. Relocate as indicated on Construction Drawings.
3. Existing inactive utilities shall be capped or plugged (below grade).

D. Connections to existing work:

1. Install new work and connect to existing work with minimum interference to existing facilities.
2. Connect new work to existing work in neat and acceptable manner. Restore existing disturbed work to original condition.

E. Removal and relocation of existing work.

1. Disconnect, remove, or relocate piping, ductwork, conduit, and other work noted or required by alterations, modifications, or changes in existing construction.
2. Plug or cap affected active lines behind or below finished walls and/or floors.
3. Dispose of removed piping and material.

F. Special Traffic Requirements:

1. Maintain emergency and service entrances so they are usable for pedestrian, truck, and emergency vehicles at all times.
2. Where trenches are cut, provide adequate bridging for above-mentioned traffic.

1.22 PROCEDURE OF WORK

A. The Contractor is hereby cautioned that although he will be permitted to conduct his work during regular working hours (see exceptions below), his work shall be performed in such a manner so as not to interfere with the conduct of regular business unless approval for such interference has been obtained from the Owner and Architect. No reimbursement shall be made to the Contractor for losses sustained due to delays and interruptions of his work to accommodate the operation and business of the Owner.

B. Regular working hours exceptions: Extended utilities shutdowns and/or major equipment changeouts.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Listed "Acceptable Manufacturers" are those considered capable of manufacturing products or equipment conforming to detailed Specifications and Schedules, and as such, are invited to compete provided the offering is comparable in every respect to scheduled or specified products, and actually conforms to the detailed Specifications and Schedule requirements. Listing herein as "Acceptable Manufacturers" does not imply "Accepted", "Approved", "Prior Approval" or any other connotation. All product offerings must be submitted for approval after Contract Award.

B. Alternate manufacturers as identified in each section will be considered under conditions specified herein.

C. Identify materials, equipment by manufacturer's name, nameplate data. Remove unidentified materials, equipment from Site.

D. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in catalog as standard with equipment. Furnish optional or additional accessories as specified.

E. Where no specific make of material or equipment is mentioned, any first-class product of reputable manufacturer may be used, provided it conforms to requirements of system and meets with acceptance.

F. Provide an authorized representative to constantly supervise work of this Division, check all materials prior to installation for conformance with Drawings, Specifications, reviewed Submittals, and reviewed Shop Drawings.

G. Conform to conditions shown and specified. Coordinate with other trades for best possible assembly of combined Work. Relocate equipment when necessitated by failures to coordinate Work or to advise Architect of conflicts in writing.

H. Material and Equipment-General Requirements

1. New.
2. Approved for use by State Fire Marshal and local building inspection department when applicable.
3. Testing agency labeled or with other identification wherever standards have been established.

4. Architect reserves right to reject items not in accordance with Specification either before or after installation.
5. Comprised to render complete and operable systems; provide additional items needed to complete installation to realized design.
6. Compatible with space allocated; modifications necessary to adjust items to space limitations at Contractor's expense.
7. Installed fully operating and without objectionable noise or vibration.
8. Design of mechanical systems is generally based on +product of the first named manufacturers cited. Where systems for product installed necessitate modification of systems shown on drawings, Contractor is responsible for installation of systems appropriate to product installed.

I. Electrical Requirements

1. Electrical Work performed under Division 21, 22 and 23 – Mechanical shall conform to requirements of Division 26 Electrical.
2. Provide weatherproof devices and installation for out-of-doors work.

## 2.2 PAINTING

A. Finish painting (other than factory applied) of mechanical equipment and associated piping and ductwork shall be as specified in Division 09 "Painting" Section(s). Provide touch up painting of prefinished mechanical products.

1. All equipment, ductwork, piping conduit and associated supports, attachments, hardware, and connectors exposed to the weather shall be properly coated, painted or otherwise protected from corrosion caused by the elements (sun, wind, rain, snow, ice, etc.).

B. Surfaces shall be left clean, debris shall be removed, and equipment shall be furnished in prime coat finish ready for finish coats.

1. Piping, Ductwork and Equipment: Clean exterior of piping, ductwork and equipment removing rust, plaster, and dirt by wire brushing. Remove grease, oil, and similar materials by wiping with clean rags and suitable solvents.
2. Motors, Pumps and Other Items with Factory Finish: Remove grease and oil and leave surfaces clean and polished.

C. Cleaning operations may be supplemented by more detailed instructions in various other Sections of this Specification.

D. Paint for high temperature piping and equipment shall be high temperature resistant, designed for the temperatures at which the system will operate.

# PART 3 - EXECUTION

## 3.1 INSPECTION

A. Verify that conditions are satisfactory for the installation of materials and equipment. Notify Architect if conditions are not satisfactory and do not commence work until conditions have been corrected.

3.2 INSTALLATION

A. Install materials and equipment in compliance with governing codes.

B. Use printed descriptions, specifications, and recommendations of manufacturers as a guide for installation of Work. Follow in all cases where manufacturers of articles used furnish directions covering points not specified or shown.

C. Equipment.

1. Assemble equipment which is required to be field assembled under the direct supervision of the manufacturers' agent.
2. Prior to the final acceptance submit letters from the manufacturers that equipment has been assembled under the direct supervision of the manufacturers' agent.
3. Accurately set and level equipment with supports neatly placed and properly fastened.
4. Properly fasten equipment in place with bolts to prevent movement.
5. Coordinate the installation of equipment with openings in structure.
6. Coordinate and fully dimension steel supports for mechanical equipment, where shown on drawings with installing contractor.
7. Provide all roof curbs for roof mounted fans, flues, piping and duct penetrations, etc.
8. Concrete.

    a. Concrete work includes forming, steel bar reinforcing, cast-in-place concrete, finishing, and grouting is specified under Division 03 Concrete.
    b. Coordinate and fully dimension concrete housekeeping pads and curbs with installing contractor; dimensions shall be as required for structural requirements.
    c. Coordinate inertia base fill with installing contractor

D. Electrical.

1. See Division 26 Electrical.
2. Install electrical devices with code required clearances and access.
3. Assist the electrical contractor in the proper connecting of all electrical wiring and equipment required for mechanical equipment.

E. Sleeves, Chases and Concrete Inserts.

1. Provide all required sleeves, chases, concrete inserts, anchor bolts, etc.
2. Sleeves, chases are prohibited in structural members, except, where shown or as directed by Architect in writing.
3. Embed no piping in concrete or masonry.

F. Waterproof Construction.

1. Comply with Division 07 – Thermal and Moisture Protection.
2. Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of mechanical penetrations and sealing penetrations in or through fire walls, floors, ceiling slabs and foundation walls.
3. All penetrations through vapor barriers at slabs on grade shall be taped and made vapor tight.

4. Provide galvanized sheet metal weather protection canopies, hoods or enclosures over all out-of-doors equipment, the operation or maintenance of which would be impaired by rainwater; this requirement applies to damper operators and bearing, damper motors, controls, and instruments; see other Sections in this Division for application of this requirement to motors, drive, ducts and fans.

G. Restoration of Damage.

1. Repair or replace, as directed by Architect, materials and parts of premises which become damaged.
2. Remove replaced parts from premises at no additional cost to the Owner.

H. Review architectural drawings and coordinate with Architect and other contractors to be sure that all architectural shafts, plenums, rated duct enclosures etc. required for mechanical systems are properly located and dimensioned.

I. Access Panels and Doors.

1. Coordinate size requirements and exact location with Contractor who will install access doors.
2. Minimum Sizes: 18 inches by 18 inches unless otherwise shown on Drawings or approved by Architect.
3. Provide where shown, or required by Regulatory Agencies, for access of all concealed equipment such as terminal units, valves, fire/smoke dampers, etc., for Mechanical Work:

   a. Equipment shall be located wherever practical over accessible ceilings or rooms to avoid access doors.
   b. Access doors shall not be used solely for access to balancing dampers; use instead remote control, devices specified under Section 233300 – Air Duct Accessories.

J. Openings.

1. Coordinate and fully dimension all openings in walls, floors, roofs, and structural elements required for mechanical work.
2. Provide all required fire-stopping around pipe, duct and other penetrations required for mechanical work in rated partitions where required by code.
3. Fire damper openings: Contractor shall provide damper UL installation requirements to contractor installing partitions to ensure construction complies with listing.
4. Air outlet openings.

   a. Contractor shall coordinate exact locations of air outlets in floors, walls and ceilings with contractor installing partition.
   b. Contractor shall coordinate additional T-bar or spline required to accept air outlets with contractor providing and installing ceiling and associated materials.

## 3.3 PROTECTION OF EQUIPMENT AND MATERIALS DURING CONSTRUCTION

A. See Division 01 – General Requirements.

B. Provide protective covers, skids, plugs or caps to protect equipment and materials from damage or deterioration during construction.

C. Store equipment and material under cover, and off the ground or floors exposed to rain.

D. For outdoor storage, protective covers of 10 mil thick black sheet plastic shall be fitted over equipment and materials. Covers shall be reinforced to withstand wind and precipitation. Set equipment and material on skids or platforms of height to avoid damage or deterioration from spattering and ground water.

E. Protect coils against damage by installing temporary closure panels over exposed coil faces. Panels shall be minimum 24-gauge sheet metal or 0.375" plywood.

F. Completely cover motors and other moving machinery to protect from dirt and water during construction.

G. Close open ends of fans, air valves, terminal units, energy recovery units, air handling units, and ductwork with temporary closures of sheet plastic taped in place.

H. Plug ends of pipes when work is stopped to prevent debris from entering the pipes.

I. Provide dust and debris protection for ductwork, coils, fans, equipment, motors, and bearings operated during construction up to date of substantial completion.

J. Cover open ends of exhaust and return ducts with temporary filter media while fan systems are operating.

K. Material, equipment, or apparatus damaged because of improper storage or protection will be rejected.

1. Remove from site and provide new, duplicate, material, equipment, or apparatus in replacement of that rejected.
2. Any porous materials, such as duct liner, insulation or flexible ductwork that becomes wet; for example, due to rain shall be replaced; drying is not sufficient (due to possible microbial contamination).

L. Perform Work in manner precluding unnecessary fire hazard.

## 3.4 ADJUSTMENT

A. Preliminary Operation.

1. Operate any portion of installation for Owner’s convenience, if so requested, by Architect. Such operation does not constitute acceptance of Work as complete but does constitute beneficial use. Cost of utilities, such as gas and electrical power, will be borne by the Owner if operation is requested by Owner.

B. Startup Service.

1. Prior to startup, ensure that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrications, venting fan balance, controls and installed and properly set relief and safety valves. See pre-function tests in Divisions 21, 22 and 23 – Mechanical.
2. Start and operate all systems.
3. Provide services of factory trained technicians for startup of major equipment and systems including boilers, chillers, fire pumps, etc.
4. Adjusting: See Section 230593 – Testing, Adjusting and Balancing for HVAC.
5. Functional Testing: See Section 230900 – Energy Management & Control Systems.
6. Life Safety Testing.

    a. Assist Division 26 Electrical contractor in testing fire alarm controls, including control of smoke dampers and shut-off of fan systems.
    b. Correct any problems related to equipment supplied under Divisions 21, 22 and 23 – Mechanical.
    c. Complete the control matrix with details such as fan tags, FSD tags, etc. based on control matrix provided with Life Safety Report.
    d. Assist Life Safety System commissioning agent in testing and commissioning Life Safety System.
    e. Provide all tests, air balance and start-up personnel required to start and commissioning the system and for assisting the design/construct team in demonstrating system compliance with the local fire district and building department.

C. Noise.

1. Cooperate in reducing any objectionable noise or vibration caused by mechanical systems to the extent of adjustments to specified and installed equipment and appurtenances.
2. Completely correct noise problems caused by failure to make installation in accordance with Contract Documents, including labor and materials required as a result of such failure, at no additional cost to the Owner.

## 3.5 SPECIAL TOOLS

A. Furnish to Owner at completion of work.

1. One set of any special tools required to operate, adjust, dismantle, or repair equipment furnished under any section of this Division.
2. Pressure gage and temperature sensor for piping test plug.

## 3.6 CLEANING

A. Cleaning.

1. See Division 01 – General Requirements.

B. Thoroughly clean equipment, fans, pumps, motors, piping, and other materials under this Division free from all rust, scale and all other dirt before any

covering or painting is done, or the systems put in operation; leave in condition satisfactory to Architect.

C. At all times keep the premises free from accumulation of waste material and debris caused by his employees. At the completion of the Project, and at other times as Architect may direct, remove refuse from within and around the building. All tools, scaffolding and surplus materials shall also be removed, leaving the Site of his Work clean.

D. Completely cover all plumbing fixtures and all motors and other moving machinery to prevent entry of dirt and water during construction.

E. Effectively cap all openings into ducts and pipes to keep moisture and foreign matter out during construction.

F. Clean and polish identification plates.

G. Clean equipment, ductwork, insulation, piping, conduit, and room surfaces from dust and dirt and maintain in a clean condition from date of substantial completion until final completion of work and corrective work.

## 3.7 PAINTING

A. Painting.

1. Piping exposed to outdoors and, where indicated elsewhere.

    a. One coat primer.
    b. Two coat alkyd oil paint, UV resistant for PVC piping, color as indicated.
    c. Not required for copper, galvanized steel, or insulated piping.

2. Steel hangers and supports exposed to outdoors.

    a. One coat primer.
    b. Not required for galvanized steel.

3. Interior of ductwork and duct accessories, including insulation stick pins, at air outlets as far back as visible from occupied spaces.

    a. Flat black.

4. Marred surfaces of factory painted equipment.

    a. Spot coat to match adjacent coat.

5. Insulation exposed to sunlight:

B. Execution.

1. Protect flooring and equipment with drip cloths.
2. Paint and materials stored in location where directed.
3. Oily rags and waste removed from building every night.
4. Wire brush and clean off all oil, dirt, and grease areas to be painted before paint if applied.
5. Workmanship.

a. No painting or finishing shall be done with:

1) Dust laden air.
2) Unsuitable weather conditions.
3) Space temperature below 60 deg F.

b. Pipes painted containing no heat and remain cold until paint is dried.
c. Paint spread with uniform and proper film thickness showing no runs, sags, crawls, or other defects.
d. Finished surfaces shall be uniform in sheen, color, and texture.
e. All coats thoroughly dry before succeeding coats are applied, minimum 24 hours between coats.
f. Priming undercoat of slightly different color for inspection purposes.

6. Piping continuously painted in all exposed areas.

C. Paint.

1. High gloss medium or long alkyd paint.
2. Best grade for its purpose.
3. Deliver in original sealed containers.
4. Apply in accordance with manufacturer's instructions.

D. Colors.

1. Colors as directed by Architect unless specified herein.
2. Interior of ductwork as far back as visible from outside: flat black.
3. Uncoated hangers, supports, rods and insets: dip in zinc chromate primer.

E. Factory Finish.

1. Ceiling and wall mounted air outlets in acoustical tile ceilings: Baked white enamel.
2. Aluminum air outlets that are not to be painted: anodized.
3. Exposed fan coil units: baked enamel.
4. Unit ventilators and unit heaters: baked enamel.
5. Fans, pumps, compressors, tanks and like items.
6. Air handlers, pumps, water heaters, and like items, where exposed.

F. Marred surfaces of prime coated equipment and piping: spot prime coat to match adjacent coat.

G. Properly prepare Work under this Division to be finish painted under Division 09 – Painting.

H. Provide moisture resistant paint for exterior painting and heat resisting paint for hot piping, equipment, and materials.

I. For the following, provide factory prime coat. Also, provide factory finish painting on each if not specified in Painting Division.

1. Other air outlets.

J. Paint all equipment out-of-doors and equipment supports with two coats of weather resistant enamel.

K. Protect all finished surfaces of fixtures with heavy paper pasted thereon, or by other means, throughout the period of construction.

L. Refinish Work supplied with final finish under this Division if damaged under this Division to satisfaction of Architect.

## 3.8 FIELD QUALITY CONTROL

A. See Division 01 – General Requirements (Quality Control).

B. Tests.

1. Perform as specified in individual sections and as required by authorities having jurisdiction.
2. Duration as noted.

C. Provide required labor, material, equipment, and connections.

D. Furnish written report and certification that tests have been satisfactorily completed.

E. Repair or replace defective work, as directed by Architect in writing, at no additional cost to the Owner.

F. Restore or replace damaged work due to tests as directed by Architect in writing, at no additional cost to the Owner.

G. Restore or replace damaged work of others, due to tests, as directed by Architect in writing, at no additional cost to the Owner.

H. Remedial work shall be performed to the satisfaction of the Architect, at no additional cost to the Owner, including:

1. Work related to all Division 21, 22 and 23 – Mechanical tests.
2. Division 21, 22 and 23 – Mechanical work related to Section 230593 – Testing, Adjusting and Balancing for HVAC.

I. Remedial work shall include performing any tests related to remedial work an additional time at no additional cost to the Owner.

## 3.9 EXISTING EQUIPMENT AND SYSTEMS

A. Owner has first right of refusal of all existing equipment and components indicated to be removed.

B. Material and equipment which has been removed and not accepted by the Owner shall become the property of the Contractor and shall be removed from the site.

C. Material and equipment which has been removed shall not be used in the new work, except as specified herein.

D. Where existing piping, ductwork and equipment is indicated on the Drawings, its size and location shall be verified.

3.10 EQUIPMENT AND INSTALLATION REQUIREMENTS

A. Air systems shall operate without aerodynamic noise generated from the faulty installation of ductwork or any component of the air distribution system.

B. Equipment shall be installed and connected as specified herein or indicated on the Drawings in accordance with the manufacturers' instructions and recommendations for this Project. Furnish and install auxiliary piping, water seals, valves, and electrical connections recommended by the manufacturer for operation.

C. Provide roughing, fittings, accessories, and connecting piping, and make final connections to all equipment. Coordinate carefully with equipment vendor prior to starting rough-in work.

D. In unfinished areas designated for future build-out, install piping, ductwork, conduit, and equipment tight against the structure to maximize future ceiling height.

E. Motor quantities, sizes and equipment wattage ratings specified herein or indicated on the Drawings are the minimum requirements, unless noted otherwise. Motor quantities, sizes, and equipment wattage ratings less than those specified herein or indicated on the Drawings are not acceptable. Larger motor sizes and equipment wattage ratings may only be provided if necessary, to meet the prescriptive requirements specified herein or indicated on the Drawings. Where multiple motors or motor sizes or equipment wattage ratings larger than specified herein or indicated on the Drawings are furnished, provide, and coordinate the corresponding increased number or capacity of feeders and other electrical equipment serving them, at no additional cost to the Owner.

F. Field-installed equipment controls or sensor wiring shall be installed in conduit. Low voltage control and sensor wiring shall be installed in conduits separate from line voltage control wiring and power wiring.

G. Where water connection sizes at equipment vary from the pipe size indicated on the Drawings, provide appropriate reducers/increasers directly adjacent to the pipe-equipment unions. Unless otherwise specified herein or indicated on the Drawings, the size of the valves and accessories dedicated to the equipment shall not be less than the pipe size to which they are connected.

H. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible and with the manufacturer’s minimum required clearances provided. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made without written approval.

1. Group concealed valves, controls, and equipment requiring access so as to be freely accessible through access doors.

3.11 DIAGRAMS

A. Frame and mount the following information:

| Information | Location |
|---|---|
| HVAC diagrams, start-stop procedures, | Appropriate mechanical |

| Information | Location |
|---|---|
| valve schedules, and valve location floor plans. | rooms. |
| Energy Management control diagrams and sequences. | Adjacent to each control panel. |
| Appropriate control and interface drawings, including a simplified guide to local programming through the digital display unit, a directory of I/O points connected to that panel, and variables which may be displayed. | Posted on the inside cover of each EMCS panel. |

B. Diagrams shall be computer generated.

C. Diagrams shall be as-built and shall include interfaces and interlocks with other equipment.

D. Diagram framing system: 0.125" thick acrylic with satin finish aluminum frames.

3.12 MAINTENANCE

A. Equipment operated prior to the date of substantial completion shall be maintained in accordance with manufacturer's recommendations. In addition, provide complete water treatment for hydronic and steam systems operated prior to date of substantial completion.

B. Prepare and submit a lubrication chart listing for each piece of equipment:

1. Points requiring lubrication.
2. Recommendations for a single manufacturer's lubricants with brand name and designation.
3. Frequency of lubrication required.

C. Lubricate each item of apparatus requiring lubrication prior to start-up in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 23 00 20 – MECHANICAL CLOSE-OUT REQUIREMENTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Summary Includes

1. As-Built Drawings.
2. Operation and maintenance documentation directory.
3. Operation manuals for systems, subsystems, and equipment.
4. Maintenance manuals for the care and maintenance of systems and equipment.
5. Closeout Documentation Checklists.

B. Related Sections:

1. Section 230010– Mechanical General Provisions.
2. Section 230030 – Demonstration and Training for Mechanical Systems.

### 1.3 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Initial Submittal: Submit draft copy of each manual a minimum of 60 days prior to requesting Substantial Completion inspection. Include a complete operations and maintenance directory. Architect will return draft copy and mark whether general scope and content of manuals are acceptable.

C. Submit manuals according to the following table.

1. "R" means required.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| As-Built drawings | | R | | |
| Operation and Maintenance Documentation Directory | | R | | |
| Operation Manual | | R | | |
| Systems and Equipment Maintenance Manual | | R | | |
| Closeout Documentation Checklists | | R | | |

| | | | | |
|---|---|---|---|---|

## PART 2 - PRODUCTS

### 2.1 AS-BUILT DRAWINGS

A. Maintain at job site a set of contract record documents kept current by indicating thereon all changes, substitutions, etc., between work as specified and as installed.

B. Show on record documents actual air quantities, water flow rates, valve, or damper positions after balancing, etc.; also show, by actual dimension, location of all new and known existing underground work.

C. At the completion of the project, furnish the Owner three sets of drawings and three complete, clean sets of specifications showing installed location, size, etc., of all work and material as taken from record documents. All as-built (on record) drawings shall be labeled "As-Built Drawings," dated and certified accurate by Contractor with his signature, on front page of all Drawing sets and Specifications.

### 2.2 OPERATION AND MAINTENANCE MANUALS

A. These operation and maintenance manual requirements supplement operation and maintenance manual documentation requirements of other Sections of these specifications.

B. Operation and maintenance documentation, in hardback 3-ring loose-leaf binders except full size drawings and CDs, shall cover the HVAC and building automation systems. Documentation shall include an operations and maintenance documentation directory, emergency information, operating manual, maintenance manual, test reports, and construction documents.

C. Initial Submittal: The operation and maintenance documentation package shall be submitted as one comprehensive package to the Owner 1 month before systems start-up, and shall be updated, revised, and completed at completion of construction.

D. Final Submittal: Provide four (4) complete manuals.

1. Correct or modify each manual to comply with Architect's comments. Submit Final manuals shall be submitted 15 working days prior to demonstration and training of Owner's personnel. Manuals are to be used in training sessions by Owner's personnel.

E. Compile and coordinate the documentation for equipment and systems installed. 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. Documentation shall be typewritten and shall contain, at a minimum, the following information.

1. Introduction:

a. Project name, contractors' and subcontractors' names, addresses, telephone numbers, email addresses and facsimile numbers. Indicate the portion of the work for which each subcontractor was responsible.
b. List of Documents.
c. List of systems.
d. List of equipment.
e. Table of Contents.

2. Operations and Maintenance Documentation Directory:

   a. Explanation of the identification system used, including lists of systems, equipment, and component identifiers and names. Use the same system, subsystem and equipment designation as 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."

3. Manual Organization: Unless otherwise indicated, organize each manual and 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:

   a. Title page.
   b. Table of contents.
   c. Manual contents.

4. Manual Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

   a. Project name, contractors' and subcontractors' names, addresses, telephone numbers, email addresses and facsimile numbers. Indicate the portion of the work for which each subcontractor was responsible.
   b. Subject matter included in manual.
   c. Name and address of Project.
   d. Name and address of Owner.
   e. Date of submittal.
   f. Name, address, telephone number, fax number and email address of Contractor.
   g. Name and address of Architect and other Architects.
   h. Cross-reference to related systems in other operation and maintenance manuals.

5. Manual 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.

   a. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table for all volumes in each volume of the set.

6. 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.

a. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2 x 11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

   1) 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 MAINTNANCE MANUAL," Project title or name, project number and subject matter contents. Indicate volume number for multiple-volume sets and six-digit Section number on bottom of spine.

b. 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 system on each divider, cross-referenced to Specification Section number and title of Project Manual.
c. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
d. Supplementary Text: Prepared on 8-1/2 x 11-inch, 20-lb/sq.ft. white bond paper.
e. Drawings: Attached reinforced, punched binder tabs on drawings and bind with text.

   1) If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

   2) If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual or reduced drawings. DO NOT USE BINDER POCKETS. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents and drawing locations.

f. Provide color photographs instead of drawings where necessary to demonstrate unusual or complex installations.

7. Emergency Information:

   a. Information for technical and nontechnical personnel about actions recommended during emergency situations to protect life and property and to minimize disruption to the building occupants. Emergencies shall, at a minimum, include:

      1) Fire.
      2) Security breach.
      3) Water outage.
      4) Power failure.
      5) Refrigerant release.
      6) Heating failure.
      7) Cooling failure.

2.3 OPERATION MANUAL

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. Valve tag lists.
10. Precautions against improper use.
11. 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 for pumps, fans, and heat exchangers.
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 of system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation and diagram controls as installed.

E. Piped Systems: Diagram piping as installed and identify color-coding where required for identification.

2.4 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, product information, maintenance procedures, repair materials, warranty information and bond information 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. Cross-reference Specification Section number and title in Project Manual.

C. Manufacturer's Maintenance Documentation: Manufacturer's 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. Manufacturer's demonstration and training videotape or DVD, if available.

E. Maintenance and Service Schedule: Include service and lubrication requirements, list of required lubricants for equipment and separate schedules for preventative 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 manufacturer's forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturer's maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of executed warranties and bonds and lists of circumstances and conditions that would affect validity of warranties and bonds.

1. Include procedures to follow and required notifications for warranty claims.

NOTE: Where manuals contain manufacturer's 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 includes 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.

2.5 CLOSEOUT DOCUMENTATION

A. Seven days prior to requesting a final inspection, the Contractor shall submit all O&M and closeout documentation to the Architect, to be submitted to the Owner at the end of the project.

B. The checklist herein shall be utilized for compiling documentation and shall be included behind front cover of O&M manuals.

C. Contractor shall initial and date each line item once completed and shall email a copy of the completed checklist to the Architect prior to final inspection request.

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. Assembly a complete set of the following manuals indicating procedures for each.

1. Emergency manual.
2. Product maintenance manual.
3. Operations and maintenance manual.

C. Manufacturer’s Data: When manuals contain manufacturer’s 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.

D. Drawings: Prepare drawings supplementing manufacturer’s printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequences 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 Drawings as part of operation and maintenance manuals.

3.2 CLOSEOUT DOCUMENTATION CHECKLIST

A. Closeout Documentation Checklists included:

1. Division 21 - Fire Protection
2. Division 22 - Plumbing
3. Division 23 - HVAC.

| CLOSEOUT DOCUMENTATION CHECKLIST<br>DIVISION 21 – FIRE PROTECTION | | |
|---|---|---|
| Project Name: | | |
| Initials of person completing task | Date task completed | Description of Contractor's Submittal |
| | | Signed Letter Record of Owners Personnel O & M Training. |
| | | DVD Record of Owners Personnel O & M Training (3 each). |
| | | Valve tag and floor plan location charts. |
| | | Pipe pressure test log. Pipe pressure tests per NFPA 13. |
| | | Provide copy of Installation and Material Certificate per NFPA 13. |

| CLOSEOUT DOCUMENTATION CHECKLIST<br>DIVISION 22 – PLUMBING | | |
|---|---|---|
| Project Name: | | |
| Initials of person completing task | Date task completed | Description of Contractor's Submittal |
| | | Final TAB Report. |
| | | Signed Letter Record of Owners Personnel O & M Training. |
| | | DVD Record of Owners Personnel O & M Training (3 each). |
| | | Operation & Maintenance Manuals. |
| | | As-Built Drawings with Contractor's Stamp. |
| | | Warranty Information. |
| | | Potable Water Sanitation Report and Certification. |
| | | Seismic Restraint manufacturer's representative certification that all installations have been installed per manufacturer's recommendations. |
| | | Pipe pressure test log. |
| | | Valve tag and floor plan location charts. |
| | | Keys to access doors, control panels, etc. (provide written receipts with Owner's acceptance). |
| | | Keys to plumbing stops and hose bibb boxes (provide written receipts with Owner's acceptance). |
| | | Provide spare Circulating Pump seals (provide written receipts with Owner's acceptance). |

| CLOSEOUT DOCUMENTATION CHECKLIST<br>DIVISION 23 – HVAC | | |
|---|---|---|
| Project Name: | | |
| Initials of person completing task | Date task completed | Description of Contractor's Submittal |
| | | Final TAB Report (3 each required). |
| | | Signed Letter Record of Owners Personnel O & M Training. |
| | | DVD Record of Owners Personnel O & M Training (3 each). |
| | | Operation & Maintenance Manuals. |
| | | As-Built Drawings with Contractor's Stamp. |
| | | Warranty Information. |
| | | Manufacturer's representative(s) shall provide certification(s) that HVAC equipment has been installed in accordance with manufacturer's recommendations. Typical for Boilers, Chillers, HVAC pumps and Central Station AHU's. |
| | | Vibration Isolation and Seismic Restraint manufacturer's representative certification that all installations have been installed per manufacturer's recommendations. |
| | | Provide list of all spare air filter sets. List number, size, type, and location/equipment match-up. |
| | | Certification by Contractor that all bearings requiring periodic lubrication, as recommended by equipment manufacturer, have been initially lubricated and have been tagged. Provide a list of all equipment lubricated. |
| | | Pipe Pressure Test Log. |
| | | Duct Pressure Test Log. |
| | | Original issue BAS (EMCS) software & |

| | | |
|---|---|---|
| | | manuals, trend logs, BAS database backup, etc. |
| | | Control sequences of operation. |
| | | Valve tag and floor plan location charts. |
| | | On a reduced floor plan drawing, the CONTRACTOR shall indicate the location of all variable frequency drives, starters, and switches. These devices shall be properly marked to indicate equipment they serve as designated on the Contract Documents. |
| | | Copy of HVAC Water Chemical Treatment Test Results |
| | | Keys to access doors. (Provide written receipts with Owner’s acceptance). |
| | | Keys to control panels and sensor/controller covers (provide written receipts with Owner’s acceptance). |
| | | Provide spare Circulating Pump seals (provide written receipts with Owner’s acceptance). |
| | | Receipt of spare fuses (provide written receipts with Owner’s acceptance). |
| | | Certification of hydronic system cleaning. |
| | | Certification of EMCS system calibration and testing. |
| | | Receipt for EMCS system training. |
| | | Receipt acknowledging no EMCS system failures during test period. |

END OF SECTION

SECTION 23 00 30 – DEMONSTRATION AND TRAINING FOR MECHANICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Administrative and Procedural requirements for preparing operation and maintenance manuals, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.

B. Related Sections:

1. Section 230010 – Mechanical General Provisions.
2. Section 230020 – Mechanical Close-Out Requirements.

### 1.3 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Initial Submittal: Submit draft copy of each manual a minimum of 60 days prior to requesting Substantial Completion inspection. Include a complete operations and maintenance directory. Architect will return draft copy and mark whether general scope and content of manuals are acceptable.

C. Submit manuals according to the following table.

1. "R" means required.

| Item | Product Data | O&M Manual | Samples | Documentation |
|---|---|---|---|---|
| Instruction program | | | | R |
| Qualification data | | | | R |
| Attendance record | | | | R |
| Evaluations | | | | R |
| DVD | | | | R |

D. Instruction Program: Submit to the Architect copies of instructional program outline for demonstration and training, including a schedule of proposed dates, times, length of instruction and instructors' names for each training module. Include learning objective and outline for each training.

1. At completion of training, submit two (2) complete training manuals for Owner's use.

E. Qualification Data: Include lists of completed projects with project names and addresses, names, and addresses of Architects and Owner and other information specified.

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

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

H. Demonstration and Training DVD's: Submit two copies of each DVD within seven (7) days of recording.

1. Format: Provide high quality color DVDs.
2. Identification: On each DVD, provide an applied label with the following information:

a. Name of project.
b. Name and address of photographer.
c. Name of Engineer.
d. Name of Contractor.
e. Date DVD was recorded.
f. Description of vantage point, indicating location, direction (by compass point) and elevation or construction story.

I. Transcript: Prepared on 8-1/2 x 11" (A4) paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with the same label information as the corresponding DVD. Include name of Project and date of DVD on each page.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative experienced in operation and maintenance procedures and training.

B. Photographer Qualifications: An individual of established reputation who has been regularly engaged as a professional video photographer for not less than five years.

C. Pre-instruction Conference: 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 and course content.

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

## PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections and as follows:

1. Heat generation including boiler, pumps, and heating water distribution piping.
2. Gas-fired heating equipment.
3. Refrigeration systems including chillers, pumps, ice storage tanks and chilled water piping.
4. HVAC systems including air-handling equipment, unit heaters, power ventilators, heat exchangers, piping specialties, etc.
5. Energy Management and Control System.
6. All control end-devices and sensors.
7. Variable Frequency Drives.

B. Training Modules (Basis of System Design, Operational Requirements and Criteria): Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participants are expected to master. For each module, include instruction for the following (this will be provided through the Architect):

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria.
3. Operating standards.
4. Regulatory requirements.
5. Equipment function.
6. Operating characteristics.
7. Limiting conditions.
8. Performance curves.

C. Training Modules (Documentation): Review the following items in detail:

1. Emergency manuals.
2. Operations manuals.
3. Maintenance manuals.
4. Project record documents.
5. Submittal manual.
6. Identification systems.
7. Warranties and bonds.

8. Maintenance service agreements and similar continuing commitments.

D. Emergencies: Include the following as applicable:

1. Instructions on meaning of warnings, trouble indications and error messages.
2. Instructions on stopping.
3. Shutdown instructions for each type of emergency.
4. Operating instructions for conditions outside of normal operating limits.
5. Sequences for electric or electronic systems.
6. Special operating instructions and procedures.

E. Operations: 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. Control Sequences.
6. Safety procedures.
7. Instructions on stopping.
8. Normal shutdown instructions.
9. Operating procedures for emergencies.
10. Operating procedures for system, subsystem, or equipment failure.
11. Seasonal and weekend operating instructions.
12. Required sequences for electric or electronic systems.
13. Special operating instructions and procedures.

F. Adjustments: Include the following:

1. Alignments.
2. Checking adjustments.
3. Noise and vibration adjustments.
4. Economy and efficiency adjustments.

G. Troubleshooting: Include the following:

1. Diagnostic instructions.
2. Test and inspection procedures.

H. Maintenance: Include 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. Procedures for routine cleaning.
5. Procedures for preventative maintenance.
6. Procedures for routine maintenance.
7. Instructions on use of special tools.

I. Repairs: Include the following:

1. Diagnosis instructions.
2. Repair instructions.
3. Disassembly: component removal, repair and replacement and reassembly instructions.

4. Instructions for identifying parts and components.
5. 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 modules. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

### 3.2 INSTRUCTION

A. Facilitator: The Architect will serve as facilitator to assist the Contractor in preparation of 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, through Architect, with at least forty-five (45) days advance notice.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written performance-based test.

E. Demonstration and Training DVD: 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.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING DVDs

A. Demonstration and Training DVDs: Record instruction of Owner's personnel in the operation and maintenance of equipment and systems. Edit DVDs to remove non-instructional conversation. Photographer shall select vantage points to best show equipment, systems and procedures demonstrated.

END OF SECTION

SECTION 23 05 00 – BASIC MECHANICAL MATERIALS AND METHODS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Administrative and Procedural requirements for preparing operation and maintenance manuals, including the following:

1. Temporary operation of mechanical equipment.
2. Wall and ceiling access panels.
3. Fire, smoke, and sound stopping.
4. Pipe Sleeves.
5. Escutcheons.
6. Dielectric Fittings.
7. Protective drip pans.
8. Non-shrink grout.

B. Related Sections:

1. Section 230010 – Mechanical General Provisions.

### 1.3 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawings |
|---|---|---|---|---|
| Wall and ceiling access panels | R | | | R |
| Fire, smoke, and sound stopping | R | | | R |
| Pipe sleeves and sleeve seals | R | | | R |
| Escutcheons | R | | | |
| Dielectric fittings | R | | | |
| Protective drain pans | R | | | R |
| Non-shrink grout | R | | | |

| | | | | |
|---|---|---|---|---|

1.4 QUALITY ASSURANCE

A. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be paid by this Contractor for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet minimum requirements.

1.5 TEMPORARY ENVIRONMENTAL CONDITIONING

A. If the Contractor requires temporary heating, cooling, and dehumidification capability prior to the permanent building HVAC system being ready for operation, it shall be the Contractor's responsibly to provide and maintain in working condition the HVAC equipment and system components necessary to meet the recommended indoor environmental conditions. All cost associated with these temporary HVAC systems shall be the Contractor's responsibility and included in their bid.

B. Additionally, if the contractor requires temporary heating, cooling, and dehumidification capability prior to the Architect approving the use of the building mechanical systems, the Contractor shall be responsible for providing and maintaining temporary HVAC systems. All cost associated with these temporary HVAC systems shall be the Contractor's responsibility and included in their bid.

1. See minimum building condition requirements herein for operation of building mechanical equipment and systems.
2. Temporary HVAC systems and controls shall be capable of providing the recommended indoor environmental conditions.

1.6 OPERATION OF BUILDING MECHANICAL EQUIPMENT AND SYSTEMS

A. Temporary operation of the building mechanical equipment and systems shall be provided for this project beginning a minimum of 60 days (or as approved by Architect) prior to the scheduled substantial completion date and maintained until the Owner's final acceptance of the project, or any phase thereof. The beginning of this temporary HVAC period is intended to align with general industry standard construction practice of providing a minimum suitable indoor environment for the installation and curing of millwork, adhesives, finishes, wall covering(s), tile ceiling/floors, etc. This interior space conditioning includes all areas of the project where the space will be similarly conditioned with heating, cooling, and/or dehumidification capability after the project or any portion/phase thereof is completed.

B. Temporary Operation of Building Mechanical Equipment and Systems Procedure:

1. The Contractor shall notify the Architect in writing fourteen (14) days in advance to request temporary operation of the building HVAC systems.

2. The Professional will schedule a site-visit to observe the site conditions to ensure all the items described below have been met prior to temporary operation.
3. The Contractor shall submit in writing an operation and maintenance plan for temporary use of the building HVAC systems. At a minimum, the O&M plan shall address:

    a. Equipment, system, and filter maintenance.
    b. Temporary filter installation locations.
    c. Daily, weekly, monthly, etc. cleaning procedures to ensure indoor cleanliness.
    d. Describe in detail how the system will be controlled, and indoor conditions monitored. Procedures for shutting down equipment or isolation of areas where dust, dirt, or particulate producing activities occur.

4. At a minimum, the following building components and activities shall be completed prior to operation of the building HVAC systems:

    a. Dust or particulate generating construction activities completed.
    b. All dirt, dust, and debris have been removed from the Mechanical Room.
    c. Piping insulation is fully completed and all seams, openings, etc. have been sealed.
    d. All HVAC system equipment utilized for temporary heating and cooling shall have been started up per specifications. All startup and warranty information (including checklists) shall be completed and submitted to the Architect.
    e. All temporary air filters in place of types and installed in locations specified in 234000 "Air Cleaning Devices." All return air and exhaust air distribution devices and openings shall be covered and protected with filter material specified in 234000 "Air Cleaning Devices." All temporary filters shall be continually monitored and replaced periodically when required.

5. Upon completion of the Architect's site visit, review of site conditions and temporary operation plan, the Architect reserves the right to refuse temporary startup and operation if site conditions and plan do not meet specifications. No additional time will be given to the Contractor due to unapproved startup and temporary operation conditions.
6. Additionally, the Architect reserves the right to order the building HVAC systems shut down if the building condition or indoor environmental conditions are found to be unacceptable.

C. The building indoor environmental conditions shall be continuously maintained within the following limits:

    1. Maximum indoor temperature: 85 ˚F dry bulb.
    2. Minimum indoor temperature: 60 ˚F dry bulb.
    3. Maximum indoor relative humidity: 60% RH.

D. Temperature and humidity data loggers shall be installed throughout the facility to record indoor environmental conditions. Data logger quantity and locations shall be approved by Architect. Data from data loggers shall be submitted to the Architect every two weeks for review. Data shall be submitted in .csv format or other, format agreed upon by Architect.

E. Contractor shall have either specified or temporary controls in place and fully operational to maintain the specified indoor environmental conditions above. Contractor shall provide all required temporary building services for temporary operation at no additional cost to the Owner.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include but are not limited to the following listed in this specification.

B. Wall and ceiling access doors.

1. Acudor.
2. Williams Brothers.
3. J.R. Smith.
4. Or equal.

C. Mechanical sleeve seals.

1. Calpico, Inc.
2. Metraflex Co.
3. Thunderline/Link-Seal.
4. Or equal.

### 2.2 WALL AND CEILING ACCESS DOORS

A. Access panels shall be provided for all concealed valves, controls, dampers, and other mechanical equipment and devices where occasional access for adjustment or repairs will be necessary. Panels shall have cam and cylinder lock with two keys. All locks shall be keyed alike. Label panels as in accordance with Section 230553 “Mechanical Identification.”

B. Size of panels to be large enough to permit servicing or replacement of devices, controls, valves, etc.; minimum size to be 18"x18". Submit schedule with submittal package indicating location and size.

C. General.

1. Fabricate units of all welded steel construction.
2. The frame and panel assembly for fire rated access panels shall be manufactured under the Factory Inspection Service of Underwriters Laboratories, Inc., and shall bear a label reading: "Frame and Fire Door Assembly, Rating 1-1/2 Hr. (B), Temperature Rise 30 Minutes, 250°F, Maximum".
3. Access panels used in toilets, kitchens, and other areas expected to experience high relative humidity are to be constructed of stainless steel.

D. Flush Panel Access Panels: Model WB-GP.

1. Frame and door shall be of one-piece unit body construction and 14-gauge steel. Body shall be 18-gauge steel with a return edge around door opening.
2. Flange shall be 1-3/4” wide.
3. Hinges shall be concealed, piano type, opening to 175 degrees. Number of hinges will vary with size of door.
4. Locks shall be flush, key operated cylinder lock. Number of locks will vary with size of door.
5. Finishes shall be factory applied with a rust inhibiting phosphated undercoat; finish to be chemically bonded oven baked white enamel.
6. For installation in masonry openings, units shall be furnished with flexible metal anchor straps welded to the body.

E. Flush Access Panel for Drywall or Plaster: Model WB-DW and WB-PL.

1. Body and flange shall be 16-gauge steel. Door shall be 14-gauge steel.
2. Hinges shall be concealed, piano type, opening to 175 degrees. Number of hinges will vary with size of door.
3. Locks shall be flush, key operated cylinder lock. Number of locks will vary with size of door.
4. Finish shall be factory applied oven baked grey enamel with rust inhibiting phosphated undercoat.
5. Plaster models shall have 2-1/2” of 24 gauge galvanized expanded wing casting surrounding door.
6. Drywall models shall have a 1-1/8” perforated drywall bead on all four sides.

F. Fire Rated “B” Label Access Panel: Model WB-FR.

1. Frame and door shall be of one-piece unit body construction and 14-gauge steel. Door shall be sandwich type filled with 2" thick thermafiber felt insulation and back enclosure of 22-gauge steel. Body shall be 16-gauge steel.
2. Flange shall be 1-3/4” wide.
3. Hinge shall be continuous steel piano type mounted on long side of doors, opening to 180 degrees, and equipped with a spring mechanism for automatic closure.
4. Lock assembly shall be self-latching with key operated cylinder lock and shall have a mechanism to release the latch bolt from the inside.
5. Finish shall be factory applied oven baked grey enamel with rust inhibiting phosphated undercoat.
6. For installation in masonry openings, units may be furnished with flexible metal anchor straps welded to the body.

## 2.3 FIRE, SMOKE, AND SOUND STOPPING

A. UL listed penetration sleeve assembly and/or firestop that meets ASTM E-814 E119, and E84, as "3M" systems or equal for the intended applications.

B. All fire, smoke and sound stopping to be done by a licensed and certified Contractor as approved by Architect.

## 2.4 PIPE SLEEVES AND SLEEVE SEALS

A. Pipe Sleeves.

1. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
2. PVC Pipe Sleeves: Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
3. Galvanized-Steel Sheet Metal Sleeves: Galvanized sheet metal sleeves with lock seam joints and comply with the following minimum thickness:

    a. 24 gauge for 3 inches and smaller.
    b. 22 gauge for 4 inches to 6 inches inclusive.
    c. 20 gauge for sizes over 6 inches.

B. Sleeve Seals: 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: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.
4. Link-Seal or equal.

## 2.5 ESCUTCHEONS (WALL, FLOOR, AND CEILING PLATES)

A. Description.

1. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
2. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
3. Split-Casting Brass Type: With polished, chrome-plated rough-brass finish and with concealed hinge and setscrew.
4. Escutcheon thickness: For wall and ceiling plates, not less than 0.025-inches for up to 3-inch pipe and 0.035-inches for larger pipe.
5. Escutcheon thickness: For floor plates, not less than 0.094-inches.

## 2.6 DIELECTRIC FITTINGS

A. Provide where copper and ferrous metal are jointed.

1. 2 inch and less: Threaded dielectric union.
2. 2-1/2 inch and larger: Flange union with dielectric gasket and bolt sleeves.
3. Temperature Rating: 210 ˚F for water systems.

## 2.7 PROTECTIVE DRAIN PANS

A. Required at following locations:

1. Fan-coil units with cooling located in attics or above ceilings where required by IMC. Not required if main drain pan includes secondary drain connection for this purpose.

    a. Size to capture any overflow from unit condensate drain pan.

2. Fan-coil units with cooling located within rooms housing electrical equipment such as power panels, control panels, transformers, and computer equipment.

    a. Size to capture any overflow from unit condensate drain pan and extended to capture drips from control valves, strainers, and unions.

B. Construction:

1. Fabricate pans of 20-gauge galvanized sheet metal or stainless steel minimum two inches deep with rolled top edges.
2. Solder all seams watertight, and cross brace pans to prevent sagging and warping.
3. Provide dielectric union at copper pipe/galvanized pan connection point. Water heater drain pans shall have minimum one inch (1 inch) drain outlet.

## 2.8 NON-SHRINK GROUT

A. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psig, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

# PART 3 - EXECUTION

## 3.1 WALL AND CEILING ACCESS PANELS

A. Coordinate size requirements and exact location with Contractor who will install access doors.

B. Minimum Sizes: 18 inches by 18 inches unless otherwise shown on Drawings or approved by Architect.

C. Provide where shown or required for access of all concealed equipment such as terminal units, valves, fire/smoke dampers, etc., for Mechanical Work. Where ceiling is constructed with removable tiles or sections, access panels are not required.

1. Equipment shall be located wherever practical over accessible ceilings or rooms to avoid access doors.
2. Access doors shall not be used solely for access to balancing dampers; use instead remote-control devices specified under Section 233300 – Air Duct Accessories.

D. Contractor shall provide substantial metal angle frame and support at all ceiling access panels.

3.2 ROOF CURB

A. All roof mounted equipment shall be furnished with a roof curb compatible with both the equipment configuration and roofing system. Curbs shall be installed level by either shimming or sloped curb construction. See detail on Drawings for more information on curb construction requirements.

B. Provide auxiliary support under all roof mounted equipment under curb base and at all penetrations as approved by Architect.

3.3 FIRE, SMOKE, AND SOUND STOPPING

A. Fire and smoke stopping shall be provided and installed at all locations where mechanical Work passes through rated assemblies. This includes all ductwork, piping, and controls related conduit.

B. Penetrations in "sound-rated" walls shall be similarly acoustically sealed, both sides of wall with caulk or other approved material. New and existing walls extending to the roof/floor structure above are considered sound walls.

3.4 PIPE SLEEVES AND SLEEVE SEALS

A. Install sleeves for pipes passing through walls, concrete beams, foundations, footings, waterproofed floors, and roof decks.

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. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Build sleeves into new walls and slabs as work progresses.
3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 7 Section "Sealants" for materials.

a. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

B. Interior wall pipe penetrations.

1. Galvanized-steel sheet metal sleeves.
2. Interior openings shall be caulked tight with fire, smoke or sound stopping material and sealant to prevent the spread of fire, smoke, and sound. Contractor shall coordinate specific requirements to ensure fire, smoke or sound ratings are maintained.

C. Above grade exterior wall, concrete beams, foundations, footings, waterproofed floors and where sleeve is extended above finished floor pipe penetrations: Seal penetrations using silicone sealant specified above.

1. Install galvanized steel or Schedule 40 PVC pipe sleeve.

D. Below grade exterior wall pipe penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install galvanized steel or Schedule 40 PVC pipe sleeve.
2. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

E. For drilled penetrations in existing floors provide one inch angle ring flange set in silicone sealant and bolted to the floor in lieu of pipe sleeves with one inch extension above floor.

## 3.5 ESCUTCHEONS

A. Install pipe escutcheons for exposed pipe penetrations of concrete and masonry walls, wall board partitions, suspended ceilings, etc.

B. Inside diameter shall fit around insulation or around pipe when not insulated; outside diameter shall cover sleeve.

C. Use plates that fit tight around insulation or pipes when not insulated.

D. Plates shall cover openings around pipes/insulation and cover the entire pipe sleeve projection. Use deep pattern escutcheons where required to completely conceal protruding fittings and sleeves.

## 3.6 DIELECTRIC FITTINGS

A. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

B. Wet Piping Systems: Install dielectric coupling, unions, and nipple fittings to connect piping materials of dissimilar metals.

## 3.7 PROTECTIVE DRAIN PANS

A. Provide pitched drain pans, where shown and required under all concealed fan-coil units with cooling, storage tank type water heaters, and all fluid conducting piping that is over electric switchgear, elevator controllers, busways or electric motor starters or as indicated. Pans shall extend minimum two inches beyond each side of the mechanical equipment, pipe or group of pipes being contained. Pans shall extend six inches beyond electrical equipment below.

B. Pitch pans shall be routed to a drain connection with discharge piped with 3/4-inch or larger copper piping to the nearest available open drain or outside as directed by Architect. Separate drain from main drain pan.

3.8 GROUTING

A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, pipe support base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Place grout, completely filling equipment bases and pipe support base plates.

E. Place grout around anchors.

F. Cure placed grout according to manufacturer's written instructions.

3.9 CUTTING AND PATCHING

A. Do not cut into any major structural element without written approval of the Architect.

B. Cut required openings through existing masonry or reinforced concrete with diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the Architect. Locate openings that will least affect structural slabs, columns, ribs, or beams. Refer to the Architect for determination of proper design for openings through structural sections and opening layouts for approval prior to cutting or drilling into structure. After Architect’s approval, carefully cut openings through construction no larger than absolutely necessary for the required installation.

C. Patching:

1. Shall be of quality and appearance matching the existing construction.
2. Contractor shall restore all services and construction that remains in use, to its condition prior to Work performed as part of this contract.

END OF SECTION

SECTION 23 05 13 – MOTORS AND CONTROLLERS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small, and medium, squirrel-cage induction motors, motor controllers (starters) and Variable Speed Drives (VSD) 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. Motors.
2. Motor controllers.
3. Variable speed drives.

### 1.3 SUBMITTALS

A. See Section 230010 “Mechanical General Provisions.”

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. “R” means required.
2. “R2” means required only for products and equipment differing for the specified manufacturer and model and for “or equals” where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Motors | R | R | | R |
| Belts and Drives | | R | | |
| Variable Speed Drives | R | R | | R |
| Motor Controllers/Starters | R | R | | R |

C. Submittals shall include certification from the motor manufacturer certifying compliance with NEMA MG-1, part 31 for motors that are driven by variable speed drives.

D. Submit a site-specific harmonic analysis showing total voltage harmonic distortion and total current harmonic distortion is in compliance with IEEE 519. If the analysis indicates that additional external devices or filters are required to meet the power quality requirements of the VSD, provide the devices or filters at no additional cost to the Owner.

## 1.4 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.

## 1.5 WARRANTY

A. Special Warranty: VSD warranty shall be 24 months from date of start-up certification including all parts, labor, travel time, and expenses.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Motors.

1. General Electric
2. Gould, Inc.
3. Baldor.
4. Or equal.

C. Variable Speed Drives.

1. Yaskawa.
2. Trane.
3. ABB.
4. Or equal.

D. Motor Controllers/starters.

1. ABB.
2. Cerus.
3. Square D.

4. Or equal.

## 2.2 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

## 2.3 MOTORS

A. General.

1. In accordance with NEMA, IEEE, and ANSI C50 standards.
2. Capacity.
    a. Minimum horsepower indicated.
    b. To operate driven devices under all conditions without overload.
3. Squirrel-cage induction type, NEMA Type "B: insulation class, continuous duty.
4. Speed.
    a. 1750 RPM, unless otherwise indicated.
    b. See schedules on drawings for other speeds.
5. NEMA KVA locked rotor CODE LETTER: "G" or better.
6. Service factor: 1.15.
7. Type unless otherwise scheduled on Drawings.
    a. Voltage: As scheduled on Drawings. Contractor shall verify actual site voltage prior to procurement.
    b. 1/2 horsepower and smaller.
        1) Single-phase phase, 60 hertz.
        2) With built-in auto-reset thermal overload protection.
    c. 3/4 horsepower and larger.
        1) Three-phase, 60 hertz.
        2) Motors 50 horsepower and over: Reduced voltage start, suitable for star-delta starting or as scheduled on Drawings.
    d. EC Motors.
        1) Where scheduled on Drawings or equipment Specifications.
        2) Equal to GE ECM version 2.2 or greater.
        3) Programmed with fan curve for “constant airflow”.
8. Bearings, unless otherwise scheduled on Drawings or equipment Specifications.

a. Provide motors with double shielded, grease lubricated, ball bearings, with grease pockets on each side for re-greasing in service. Provide inlet and outlet grease connections in motor housings for each bearing. Provide factory sealed permanently lubricated ball bearings on roof mounted equipment. Similar bearing may be provided on fractional horsepower motors. Provide sleeve bearings where so specified.
b. Ball type, unless otherwise noted.
c. Sealed, permanently lubricated, unless otherwise noted or not available in motor size.

B. Enclosure.

1. Open drip-proof (ODP).

a. Provide ODP motors unless otherwise indicated.

2. Totally enclosed (TEFC).

a. Motors outside the building or otherwise exposed to the weather.
b. Non-ventilated: under 1/2 horsepower.
c. Fan-cooled: 1/2 horsepower and larger.

3. See schedules on drawings for other enclosures.

C. Belt-connected motors.

1. Foundation slide base.
2. Shaft as required for aligning pulleys.

D. Motors 1 horsepower and larger shall be NEMA Premium labeled and have guaranteed efficiencies equal to or exceeding NEMA Table 12-6D.

E. Multi-speed motors.

1. Two speed motors shall be single winding 1800/900 rpm unless otherwise specified or indicated.
2. Provide 1800/1200 rpm multi-speed motors of separate winding, variable torque type, unless otherwise specified or indicated.

F. Motors driven by variable speed drives.

1. Shall meet the requirements of NEMA MG-1 part 31.40.4.2.
2. Where used for pumps or fans shall be capable of operating at 10 percent speed indefinitely.

G. Electrically Commutated Motors (EC Motors).

1. Brushless DC type with electronic commutation from 115 volt or 277 volt single phase power to a DC signal.
2. Speed controllable from a minimum of 20% or less to 100% of full speed.
3. Minimum 80% efficiency at all speeds.
4. Provide the following.

a. Potentiometer dial mounted on the exterior of the motor housing.
b. 0-10 VDC control signal input and 0-10 VDC speed feedback output with pre-wired contacts. Motor shall shut off when speed signal is below minimum.

## 2.4 VARIABLE SPEED DRIVES

A. All variable speed drives other than those that are factory packaged with equipment shall be supplied by one manufacturer.

B. Electrical Characteristics.

1. Efficiency shall be not less than 97 percent at rated voltage, current, and frequency and fundamental power factor shall not be less than 98 percent at all speeds and loads.
2. VSD shall maintain line noise (voltage harmonics) on the input electrical system at or below levels specified in IEEE 519 for a "General System." Manufacturer shall include in submittals a harmonic distortion analysis (IEEE 519, 3 percent) for this particular jobsite. Provide as a minimum 5% impedance line reactors. The 5% impedance may be from dual (positive and negative DC bus) reactors or 5% AC line reactors. VSDs with only one DC reactor shall include AC line reactors.
3. VSD shall include EMI/RFI filters that allow the VSD assembly to be CE Marked and meet product standard EN 61800-3 for the First Environment restricted level.

C. Features and Accessories.

1. Plain language LCD display (code numbers not acceptable); all set-up parameters, indications, faults, warnings, and other information must be displayed in words, not codes.
2. Displays and meters for the following: Output voltage, output frequency, motor rpm, motor current, motor watts, speed signal input, last three faults.
3. Hand-Off-Auto keyboard function with manual speed control, including bump-less transfer of speed reference when switching between Hand and Auto modes.
4. Input line fuses.
5. Adjustable or multiple carrier frequencies up to 12 kHz. Include a carrier frequency control circuit that reduces the carrier frequency based on actual VSD temperature that allows the highest carrier frequency without de-rating the VSD or operating at high carrier frequency only at low speeds.
6. Isolated 4-20 mA or 0-10 Vdc speed signal input. If the input reference is lost the VSD shall, based on user selectable option, either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the speed based on the last good reference received, or (4) cause a warning to be issued.
7. Analog outputs for kW and speed; kW shall be accurate to ±3%.
8. Digital outputs for alarm and motor on/off status; latter shall be based on field adjustable motor current that can indicate broken belt or coupling.

9. Ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable for each fault type.
10. Controls.

    a. Provide a minimum of two digital outputs that can be programmed for multiple purposes and also controlled through the DDC network interface device by the DDC system independent of other VSD functions or status. Control sequence possibilities shall include:

        1) Contact to open fan discharge damper either with fan start or independent of fan operation, controlled via the DDC system and wait for the damper end switch to make before starting the drive; this shall function in the normal drive mode, bypass mode, and life safety mode (if part of smoke control system).

    b. For fans used as part of IBC smoke control system, include:

        1) Programmable digital input that, when external contact is closed by life safety control system, causes VSD to start and operate at a preset adjustable speed, overriding automatic speed and on/off controls, manual speed settings and all keypad and HOA commands.
        2) "Run to destruct" option so that when the digital input is closed, all internal and external safeties that might prevent the VSD from operating at the preset speed will be ignored or overridden.

    c. Provide built-in PID control loop, allowing connection of a pressure or flow signal to the VSD for closed loop control.
    d. Provide factory installed BACnet/MSTP network interface that allows all VSD control points to be communicated to EMCS. See Section 230900 "Energy Management & Control Systems-General." At a minimum, the following points shall be provided:

        1) Read only: Speed feedback, output speed, current, % torque, kW power, kilowatt hours (resettable), operating hours (resettable), drive temperature, digital input status, analog input values, all diagnostic warning and fault information, keypad "Hand" or "Auto" selected, deceleration rate, and acceleration rate.
        2) Read/write: On/off, output speed, digital output open/close, analog output values, remote fault reset, PID setpoint and gains, force the unit to bypass, maximum speed, and minimum speed.

11. Enclosure.

    a. NEMA 3R enclosure for outdoor installation or unconditioned space.
    b. NEMA 1 enclosure for indoor installation in conditioned space or indirectly conditioned space such as return air plenum.

c. UL Type 12 for wet mechanical rooms.
d. UL listed as plenum rated where located in supply, return, or outdoor air stream.

12. Thermostatically controlled cooling fans shall be provided where required to meet ambient operating conditions. Fans shall be designed for replacement without requiring removal of the VSD from wall mount or removal of circuit boards. Fan sound power shall be no greater than local noise sources where VSD is installed.
13. 3-contactor, constant speed bypass shall be provided to allow the motor to run across the line in the event of VFD shutdown. The transfer from the VFD to the line shall be accomplished manually by means of a selector switch. The bypass circuitry shall be enclosed in a separate well-mounted NEMA 1 cabinet. The bypass cabinet shall include a door interlocked input circuit breaker, a VFD output contactor, and a full voltage starting contactor (both contactors electrically interlocked), a thermal overload relay to provide motor protection, and a control power transformer. Mounted on the cabinet door shall be the bypass selector switch, motor fault light, power ON light, motor on VFD light, and motor online light.

D. Equipment Protection and Safeties.

1. VSDs short-circuit interrupting rating shall equal or exceed that fault current available at the drive.
2. VSD shall protect itself against all normal transients and surges in incoming power line, any grounding or disconnecting of its output power, and any interruption or run away of incoming speed signal without time delay considerations. Protection is defined as normal shutdown with no component damage.
3. The VSD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The VSD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.
4. VSD shall protect itself against all phase-to-phase or phase-to-ground faults.
5. VSD shall be able to start into a rotating load at all speeds (forward or reverse) without trip.
6. Anti-regeneration circuit shall match the deceleration rate of the drive to that of the motor to prevent high bus voltage shutdown common to high inertia loads, such as fans.
7. VSD shall ride through an input power dip of 3 cycles without trip.
8. VSD shall operate properly at a -35% +30% voltage fluctuation from rated voltage.
9. VSD shall operate properly at a 10 percent frequency variation from rated frequency.
10. VSD shall employ three current limit circuits to provide trip-free operation: slow current regulation, rapid current regulation, and current limit switch-off limit. VSD shall be

designed so that overcurrent trip shall be at least 315 percent of the drive's current rating.

11. VSD shall have the ability to set a maximum current available to the motor.
12. VSD shall withstand unlimited switching of the output under full load, without damage to the VSD. Operation of a disconnect switch between the motor and VSD shall not have an adverse effect on the VSD, whether the motor is operating or not. Controls conductors between the disconnect and the VSD shall not be required for the safe and reliable operation of the VSD.
13. The VSD shall withstand switching of the input line power up to 20 times per hour without damage to the VSD.
14. The VSD shall be capable of operating continuously at full load in the following service conditions

    a. Ambient temp: 30 to 104 degrees Fahrenheit.
    b. Relative humidity: 0 to 95 percent, non-condensing.

E. Warranty shall be 24 months from date of start-up certification including all parts, labor, travel time, and expenses.

## 2.5 MOTOR CONTROLLERS/STARTERS

A. General.

1. Manual reset, Class 20, thermal type overload protection for each phase, in accordance with NEMA ICS 2-2000 (R2005).
2. NEMA 3R enclosures for exterior application.
3. Equipment furnished with factory-installed starters shall also be equipped with individual motor disconnect and thermal magnetic circuit breakers or fuses as specified herein with lugs sized to receive a feeder as indicated on the Electrical Drawings.
4. 120 V secondary control power transformer with fused primary and secondary circuit in the enclosure.
5. Unused auxiliary contacts (installed on each contactor): 1 normally open, and 1 normally closed.

B. Motor starters shall be provided with provisions for interfacing with the Energy Management and Control System (EMCS) or other control and interlocking requirements.

1. For all magnetic starters, a minimum of one set of field reversible auxiliary contacts shall be provided with the starter.

C. For 3-phase motors, unless otherwise specified herein:

1. Combination magnetic type and thermal magnetic circuit breaker with:

    a. Circuit breakers having minimum AIC rating as specified in Division 26.
    b. External operating handle capable of being locked in the off or open position.
    c. Hand-off-automatic switch, except those manually controlled.

d. Starters for motors 50 hp and larger shall be solid-state, reduced-voltage type.

D. For 1-phase, unless otherwise specified herein:

1. Manual starting switch with thermal overload protection and pilot light.

2. Hand-off-automatic switch.
3. Magnetic across-the-line starters with overload protection and Hand-Off-Automatic switch, except for manually controlled equipment.

E. Provide control transformers for equipment with voltage above 240 volts, or as required for complete, operable systems.

F. Coordinate with DIVISION 26: ELECTRICAL.

G. Refer to individual equipment sections for factory-provided controllers.

1. Installed on equipment by manufacturer.
2. Supplied with equipment by manufacturer for field installation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Coordinate with work of other trades.

B. Install in accordance with manufacturer’s written installation instructions.

C. Drives for packaged equipment shall be mounted and wired by equipment manufacturer.

D. Mounting and power wiring of field mounted variable speed drives and other motor controllers is specified under Division 26 Electrical:

1. Where wall space is not available for mounting VSDs or other motor controllers, provide mounting struts securely mounted to the floor, roof, or adjacent structure.
2. Where VSD has disconnect switch, locate VSD within sight of equipment served so that switch complies with NEC requirements.

E. Set overload devices to suit motors provided in accordance with NEC.

### 3.2 INSTALLATION

A. Verify that adequate clearance between motor, controllers and adjacent walls or equipment is available to permit maintenance and repairs.

B. Check that motor and controller are properly supported and allows for proper alignment and tension adjustments as necessary for application.

## 3.3 PRE-OPERATING CHECKS

A. Before operating motors and controllers.

1. Check for proper and sufficient lubrication.
2. Check for correct rotation.
3. Confirm alignment and re-align if required.
4. Check for proper adjustment of vibration isolation.

## 3.4 STARTUP, TESTING AND ADJUSTING

A. Start and test motors and controllers in accordance with manufacturers written installation instructions.

B. After starting motors.

1. Check for high bearing temperatures.
2. Check for motor overload by taking ampere reading at maximum operating conditions, with all valves open and individual motor running.
3. Check for objectionable noise or vibration; correct as needed at no additional cost to the Owner.

C. Variable speed drives.

1. Certified factory start-up shall be provided. A certified start-up form shall be filled out for each VSD with a copy to the Architect and a copy kept on file by the manufacturer.
2. See Section 230900 “Energy Management and Control Systems-General” for points to be mapped from the drive controller to the EMCS; coordinate information addresses and other information required with the Section 230900 “Energy Management and Control Systems-General” contractor.
3. Set variable speed ramp-up rates on variable air volume systems slow enough to prevent high pressure trips and/or damage to duct systems. Coordinate with Section 230900 EMCS contractor.
4. Set minimum speed for all applications in accordance with procedure indicated in Section 230900 “Energy Management and Control Systems-General.”
5. Set maximum current limit setpoint to the motor to the motor's full load amps.
6. Set voltage to speed ratio (V/f) to “squared”.
7. For fans such as relief fans and cooling tower fans: Run fan through entire speed range and program out speeds that cause fan vibration.
8. After VSD is fully configured and programmed, all settings shall be documented and included with commissioning documentation in electronic format per Section 230010 Mechanical General Provisions. The intent is to allow replacement drive electronics to be readily configured.

D. Motor Controllers/Starters.

1. Provide starters, push buttons, thermal overload switches, and contactors for equipment covered in Division 23 unless otherwise specified herein. Installation of starters, push buttons, and thermal overload switches, not factory installed, is specified under Division 23.
2. Provide 120 V secondary control power transformers for control circuits where equipment is served at 208 V or higher.

E. See Section 230593 "Testing, Adjusting, and Balancing for HVAC."

## 3.5 TRAINING

A. See Section 230010 "Mechanical General Provisions."

B. VSD manufacturer to provide one of the following:

1. 8-hours of customer training.
2. Interactive Computer based training on VSD installation, start-up, programming, and trouble shooting.
3. Professionally produced video cassette on VSD installation, start-up, programming, and trouble shooting in digital format.

END OF SECTION

SECTION 23 05 19 - METERS AND GAUGES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Light-activated thermometers.
2. Duct-thermometer mounting brackets.
3. Thermowells.
4. Dial-type pressure gauges.
5. Gauge attachments.
6. Test plugs.

### 1.3 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Thermometers | R | R | | |
| Thermowells | R | | | |
| Pressure gauges | R | R | | |
| Gauge attachments | R | | | |
| Test plugs | R | | | |

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models are acceptable.

B. Thermometers:

1. Weksler.
2. Weiss.
3. Trerice.
4. Or equal.

C. Pressure gauges:

1. Weksler.
2. Weiss.
3. Trerice.
4. Or equal.

D. Pressure-temperature test plugs:

1. Peterson Engineering Company.
2. Taco.
3. Watts.
4. Or equal.

### 2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Standard: ASME B40.200.
2. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
3. Case Form: Adjustable angle unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue organic liquid.
5. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg. F.
6. Window: Glass.
7. Stem: Aluminum and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

8. Connector: 1-1/4 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.
10. Weiss 9VU or equal.

2.3 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.4 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 or CUNI.
4. Material for Use with Steel Piping: CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, 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.

2.5 PRESSURE GAUGES

A. Pipe or equipment mounted type.

1. Standard: ASME B40.100.
2. Diameter: 4 1/2 inch, except as noted.
3. Case: black finished cast aluminum with flangeless back.
4. Threaded black cast aluminum ring with gasketed glass face.
5. Type 316 stainless steel spring tube.
6. Stainless steel precision movement: Micrometer adjustment on needle.
7. Accuracy: 0.5 of 1 percent full scale range.
8. With calibration adjustment.
9. Quarter turn stop cock: Materials compatible with service.
10. Pressure snubbers.

    a. Filter type.
    b. For liquid, air and gas.

11. Weksler Type AA44 or equal.

2.6 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of stainless-steel pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.7 TEST PLUGS

A. Description: Test-station fitting made for insertion in piping tee fitting.

B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

C. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

D. Minimum Pressure and Temperature Rating: 500 psig at 275 deg. F.

E. Core Inserts: Nordel self-sealing rubber.

F. Pete’s Plug: No. 110 with yellow cap or equal.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter 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 at the most readable position.

F. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gauge for fluids (except steam).

H. Install valve and syphon fitting in piping for each pressure gauge for steam.

I. Install test plugs in piping tees.

J. Install test plugs at all temperature, pressure and flow sensors for calibration. See Section 230900 Energy Management and Control Systems-General.

## 3.2 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

## 3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gauges to proper angle for best visibility.

## 3.4 THERMOMETER SCHEDULE

| Installation Location | Thermometer Type | | |
|---|---|---|---|
| | Industrial (Metal) Liquid-in Glass | Direct-Mounted Light-Activated | Test Plug w/Nordel Core |
| Hydronic Zone | X | | X |
| Heat Pump Coil Inlet and Outlet | X | | X |
| Where indicated on Drawings | X | | X |

A. Thermometer stems shall be of length to match thermowell insertion length.

B. Test plug with Nordel core self-sealing rubber inserts where shown on Construction Drawings. Also locate adjacent to all EMCS temperature/pressure wells for calibration.

## 3.5 THERMOMETER SCALE-RANGE SCHEDULE

| Application | Scale Range |
|---|---|
| Condenser Water | 0 - 150 deg. F |

3.6 PRESSURE-GAUGE SCHEDULE

| Installation Location | Pressure Gauge Type | |
|---|---|---|
| | Liquid-filled (Metal) Direct-Mounted | Test Plug w/Nordel Core |
| Pressure-Reducing Valve | X | X |
| Heat Pump Coil Inlet and Outlet | X | X |
| Pump Suction and Discharge | X | X |

3.7 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

| Application | Scale Range |
|---|---|
| Condenser Water | 0 – 100 psig |
| Heat Pump Coil | 0 – 100 psig |
| Pressure gauges indicated on drawings or specifications, not indicated herein | Submit with appropriate range for review |

END OF SECTION

SECTION 23 05 23- VALVES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Work Included in This Section: Materials, equipment, fabrication, installation, and tests in conformity with applicable codes and authorities having jurisdiction for the following:

1. Service valves in hydronic and plumbing systems (other than gas and fire sprinkler).
2. Balancing valves.
3. Check valves.
4. Pressure reducing valves.
5. Safety and relief valves.
6. Vent and gas cocks.
7. Manual and automatic air vents.
8. Miscellaneous valves.

B. Related Sections:

1. Section 211300 – Fire Suppression Systems.
2. Section 221116 – Domestic Water Piping.
3. Section 232113 – Hydronic Piping.

### 1.3 QUALITY ASSURANCE

A. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

### 1.4 SUBMITTALS

A. See Section 230010 Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop and coordination drawings according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Valves, all types | R | R | | R |
| Valve accessories (handle extensions, operators, etc.) | R | | | |
| Manual and automatic air vents | R | R | | |
| Pressure/temperature test plug | R | R | | |

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Ball, gate, and check valves.

1. Nibco Inc.
2. Crane Company.
3. De Zurik Corporation.
4. Or equal.

C. Gate valves – buried.

1. Mueller Company.
2. Kennedy Valve Mfg. Company.
3. Clow Corporation.
4. Or equal.

D. Butterfly valves.

1. Nibco Inc.
2. Crane Company.
3. De Zurik Corporation.
4. Or equal.

E. Balancing valves.

1. ITT Bell and Gossett.
2. Taco Inc.
3. Watts.
4. Or equal.

F. Silent check valves.

1. Nibco Inc.
2. Grinnell.
3. Mueller Steam Specialty.
4. Or equal.

G. Combination check and shut-off valves and Triple duty valves: Not allowed.

H. Pressure reducing valves-air and water. Safety and relief valves.

1. Watts.
2. Consolidated.
3. ITT Bell and Gossett.
4. Or equal.

I. Vent cocks.

1. Weiss.
2. Weksler.
3. Crane Company.
4. Or equal.

J. Automatic air vents.

1. Amtrol.
2. ITT Bell and Gossett.
3. Dole Valve Company.
4. Or equal.

2.2 GENERAL

A. Where possible, provide valves of same manufacturer for all Mechanical Sections per products in this Section.

B. For copper tubing provide solder-joint valves, flare fittings, or IPS-to-copper adaptor, sized for use with tubing and respective valve.

C. For flanged valves, provide streamline companion flanges, ANSI B16.5, 1988 150 class pounds per square inch.

1. 255 pounds per square inch water on gauge (WOG) at 150-degree Fahrenheit.
2. 225 pounds per square inch water on gauge (WOG) at 250-degree Fahrenheit unless indicated otherwise.

D. Provide valves rated not less than 125 pounds per square inch steam working pressure, unless indicated otherwise.

E. Provide valve materials suitable for service and temperature of respective systems, especially with respect to discs, plugs, balls, linings, gaskets, and lubricants of globe valves, plug cocks, ball valves, etc.

F. Provide chain-operated hand wheels, rustproof chain, and chain guide for following valves.

1. Provide chain-operated hand wheels, rustproof chain, and chain guide for following valves.
2. As noted.

G. Valves in Insulated Piping: With 2-inch (minimum, greater if insulation thickness is greater than 2 inches) stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. Nibco Nib-seal handle extension or equal.
2. Butterfly Valves: With extended neck.

## 2.3 BALL VALVES

A. 2-1/2 inches and smaller.

1. Two-piece body, bronze ASTM B584 C84400.
2. 316 stainless steel stem and ball.
3. PTFE Seat.
4. Full Port 1/2 to 1 inch; Standard Port 1-1/4 and larger.
5. 600 pounds per square inch at 100-degree F, 125 pounds per square inch saturated steam.
6. Infinite throttling handle with memory stop.
7. Nibco 585-70-66 or equal. Nibco 580-70-66 or equal may be used for 1-1/4 inch and larger.

## 2.4 GATE VALVES

A. General.

1. 2 inches and smaller, Bronze.

a. Class 125 (125 psi steam, 200 psi water).
b. Solid wedge.
c. Union bonnet.
d. Inside screw.
e. Rising screw.
f. Rising stem.
g. Equal to Nibco.

1) Threaded: T-124.
2) Soldered: S-134.

2. 2-1/2 inches and larger.

a. Iron body.
b. Bronze trim.
c. Class 125 (125 psi steam, 200 psi water).
d. Solid wedge.
e. Outside screw and yoke (OS&Y).
f. Flanged.
g. Equal to Nibco

1) 125 pounds per square inch: F-617-O.
2) 250 pounds per square inch: F-667-O.

B. Gate Valves – Hose.

1. Cast Bronze.
2. 200 pounds per square inch water working pressure.
3. Rising stem.
4. Polished chrome plated.
5. Satin chrome.
6. Rough bronze.
7. Polished bronze.
8. NFPA approved.
9. Cap chained to valve body.
10. With escutcheon.
11. Hose threads per requirements of Fire Authority having jurisdiction.
12. Equal to Potter-Roemer.

    a. 2-1/2 x 2-1/2 = 4315.
    b. 2-1/2 x 3 = 4335.

C. Gate Valves – Direct Buried.

1. AWWA C500.
2. Federal Specification WW-V-586, Type II, Class1.
3. Cast iron.
4. Pressure ratings: 2-12 inches - 200 pounds per square inch working, 400 pounds per square inch test; 14 inch and larger - 150 pounds per square inch working, 300 pounds per square inch test.
5. Double disc, parallel seat.
6. Non-rising stem.
7. Joint ends to match piping.
8. Equal to Clow Series F-5062 through F-5085.

D. Valve Indicator Posts.

1. U.L. listed.
2. Two-piece.
3. Non-rising stem.
4. Equal to Nibco NIP-1AJ.

E. Lockshield Gate Valves: Same as gate valves, except key operated.

## 2.5 BUTTERFLY VALVES

A. Flange Type:

1. Iron body.
2. 316 or 416 stainless steel stem continuous with pinned disc.
3. Disk shall be either:

    a. 316 stainless steel.
    b. Aluminum bronze.
    c. Nickel encapsulated ductile iron.
    d. EPDM encapsulated ductile iron.
    e. Nylon encapsulated ductile iron.

4. Steel seat or cast-iron support ring.
5. EPDM body and stem seal.
6. Bronze or copper bushings.
7. Factory tested bubble-tight at 150 pounds per square inch.

B. Type:

1. Lug Type:

a. Equal to Nibco Series LD-2000.
b. Lugs drilled and tapped to match ANSI 150 flanges.
c. Recommended by manufacturer or dead-end service at full pressure without the need for downstream flanges.
d. Use cap screws both sides.

C. Operator:

1. Infinite throttling handle with memory stop: smaller than 8 inches.
2. Gear operators: 8 inches and larger.

## 2.6 BALANCING VALVES

A. Calibrated Balancing Valves.

1. Combination balancing and shut-off valves.
2. Calibrated name plate and adjustable memory stop.
3. Capped read-out valves.
4. Pre-formed insulation for chilled water valves.
5. Provide one differential pressure read-out meter for all valves in system.
6. 2-1/2 inches and smaller:

a. Brass body.
b. 304 stainless steel ball.
c. Soldered or threaded ends.
a. Teflon or TFE seats.
b. 250 pounds per square inch at 250 degrees Fahrenheit.

7. 3 inches and larger.

a. Ductile or cast-iron body.
b. Flanged.
c. 175 pounds per square inch at 250 degrees Fahrenheit.

8. Devices using venture type flow meter not acceptable (due to propensity for clogging and ease of putting valve with limited flow range in wrong direction).
9. Devices using Pitot tube or Annubar type flow meter not acceptable (due to propensity for clogging).
10. Devices using other than ball or butterfly valves shall not be used for coil isolation – a separate ball valve or butterfly valve shall be added for isolation (to ensure positive shut-off and to allow 90˚ open-close with memory stop) whether shown on schematics or not.

11. Bell & Gossett Circuit-Setter Plus or equal.

B. Combination shut-off, balancing, and check valve: Not allowed.

## 2.7 CHECK VALVES

A. Check Valves, General Service.

1. 2 inches and smaller.

a. Swing check.
b. Class 125 (125 psi steam, 200 psi water).
c. Bronze disc.
d. Screw-in cap.
e. Soldered ends.
f. Equal to Nibco S-413-W.

2. 2-1/2 inches and larger.

a. Swing Check.
b. Class 125 (125 psi steam, 200 psi water).
c. Bronze disc and seat ring.
d. Bolted cap.
e. Flanged body.
f. Equal to Nibco F-918-8.

B. Silent Check Valves.

1. For pump discharges:

a. Except sump pumps and sewage ejectors.
b. Variable speed pumps. Check valve pressure drop shall vary roughly as the square of flow rate to near zero flow. Valves that use hydrodynamic profiles (e.g. Victaulic 716 check valve) resulting in high or erratic pressure drop at low flow rates are not acceptable.

2. 2 inches or smaller.

a. Center-guided, silent check.
b. Class 125 (125 psi steam, 200 psi water).
c. Bronze trim.
d. Equal to Nibco 480.

3. 2-1/2 inches or larger.

a. Globe body silent check.
b. Class 125 (125 psi steam, 200 psi water).
c. Bronze trim.
d. Center-guided.
e. Flanged body.
f. Equal to Nibco F-910.

2.8 PRESSURE REDUCING VALVES

A. 2 inches and Smaller.

1. Bronze body, solder or threaded.
2. Equal to Watts Series 223.

B. 2-1/2 inches and Larger.

1. Iron body, flanged.
2. Equal to Watts No. 2300.

2.9 SAFETY AND RELIEF VALVES

A. General.

1. Constructed, rated, and stamped in accordance with Section IV of the ASME Boiler and Pressure Vessel Code.
2. Direct spring-loaded type.
3. Adjustable discharge pressure setting.
4. Bronze body and all wetted parts shall be non-ferrous.
5. Suitable and rated for system pressure and temperature.

B. Set pressures.

1. Set pressure as indicated on Drawings: Not to exceed pressure rating of protected equipment.
2. Valves to open, under test, at set pressure with following tolerance:

    a. Set pressure up to 70 pounds per square inch gauge: plus or minus 2 pounds per square inch.
    b. Set pressure, above 70 pounds per square inch gauge: plus or minus 3 percent.

C. Capacities.

1. Valves shall have capacity to relieve maximum possible generated energy while maintaining pressure in protected equipment at no more than 10 percent above vessel working pressure.
2. Greater than make-up pressure reducing valve capacity.
3. Equipment relief valve capacity to exceed rating of connected equipment.
4. For boiler relief valves, the valve shall have a BTU/h rating in excess of the BTU/h rating of the boiler’s heating output.
5. Provide multiple valves if required for capacity even though only one valve may be shown on Drawings.

D. Maintain pressure in protected equipment at not more than the following:

1. Low pressure Boilers: 5 pounds per square inch above boiler working pressure.
2. High pressure Boilers: 6 percent above boiler working pressure.

3. Unfired Pressure Vessels: 10 percent above vessel working pressure.

E. Safety and Relief Valves: Equal to Consolidated.

F. Relief Valves, Water: Equal to Watts.

## 2.10 VENT AND GAUGE COCKS

A. Bronze body, 1/4-inch size.

B. Lever handle.

C. 125 pounds per square inch steam working pressure.

D. Equal to Weiss LC-14.

## 2.11 MANUAL AIR VENTS

A. Construction.

1. Vertical.
2. Provide 1/4-inch brass needle valve at top of chamber.
3. To 3-inch pipe: Line size air chamber, 12 inch long.
4. 4 inch to 8 inch: Line size air chamber, 6 inch long.
5. 10 inch and larger: Line size pipe cap.

## 2.12 AUTOMATIC AIR VENTS

A. Float type.

1. With isolating valve.
2. Brass or semi-steel body.
3. Float copper or stainless steel.
4. Stainless steel valve and valve seat.
5. Suitable for system operating temperature and pressure.
6. Non-opening on negative pressure.
7. Equal to Thrush/Amtrol No. 720.

B. Disc type.

1. All brass with hydroscopic fiber discs.
2. Vent ports.
3. Adjustable cap for manual shut-off.
4. Integral spring-loaded ball check valve.
5. Equal to Dole.

C. Threaded vent connection for piping vent to drain.

D. Upstream ball valve for isolation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Coordinate with work of other trades.

B. Install valves in accordance with manufacturer's written installation instructions.

C. Provide valves as shown on drawings and provide shutoff valves around all equipment whether shown with valves on drawings or not.

D. Provide all valves (except control valves), strainers, and check valves of same size as the pipes in which they are installed unless otherwise indicated.

E. Pressure rating of valves same as piping in which installed.

F. Install valves with stems upright or horizontal, not inverted.

G. Install valves with cast directional arrows in direction of flow.

H. Support line valves at the valve in addition to regularly spaced pipe supports shown and specified.

I. Check valves:

1. Provide silent check valves at discharge of pumps. Triple duty valves shall not be used as a substitution for check and shut-off valve.
2. Install swing checks and gravity closing lift checks in horizontal position.

J. Butterfly valves:

1. Piping adjacent to lug type shall be flange removable while valve is in use.

K. Control valves:

1. See Section 230913 – EMCS Basic Materials and Devices for valve specifications.
2. Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where the actuator top and position indicator are below 5 feet above the floor, install with valve stem axis vertical with actuator side up. Otherwise, valves shall be installed with stem horizontal so that the position indicator is visible from the floor. Do not install valves with stem below horizontal or down.

L. Provide blow-down ball valves and hose adaptors at strainers, air separators, tanks, pipe traps, equipment drains, etc. of same size as strainer blow-off connection.

M. Provide drain valves at main shut-off valves, low points of piping and apparatus.

N. Provide extended valve stems to clear insulation on insulated valves.

O. Locate wheel handles to clear obstructions with hand.

P. Install valves only in accessible locations.

Q. Wherever possible, install valves accessible from floor level. Provide guided chain operators on valves over 7 feet above floor in equipment areas. Extend chains to within 6 feet 6 inches of floor.

R. Locate equipment shut-off valves to be accessible without climbing over equipment.

S. Provide operating handles for all valves and cocks without integral operators, unless otherwise noted. Provide adequate clearance for easy operation.

T. Provide discharge pipe to atmosphere from all relief and safety valves, sized with area equal to sum of outlet areas of all valves connected thereto, unless indicated larger. Extend to over code compliant drain receptacle with airgap.

U. Provide ball valves to isolate shock absorbers.

V. Provide open-ended line valves with plugs or blind flanges.

## 3.2 VALVE APPLICATIONS

A. Valves shall be limited to the applications listed below. Where this section disagrees with drawings, obtain clarification from Architect, and provide as directed by the Architect at no additional cost to the Owner.

B. Ball valves:

1. Throttling and shut-off: water.
2. Use in HVAC, domestic water, and general fire protection piping 2-1/2 inches and smaller.

C. Butterfly valves:

1. Throttling and shut-off: water.
2. Use in HVAC, domestic water, and general fire protection piping 3 inches and larger.

D. Gate Valves:

1. Hose drains.
2. Direct buried.
3. Not used for general shut-off (ball or butterfly only for general shut-off).

3.3 AIR VENTS

A. Manual air vents.

1. Locate:

a. As shown on drawings.
b. At all high points in closed piping systems.
c. At equipment with vents, such as coils.

2. 1/4-inch copper tube discharged into nearest drain or with 180-degree bend to discharge into portable container.
3. Extend tubing or piping as required to make valve accessible.

B. Automatic air vents.

1. Locate:

a. As shown on drawings.

2. Provide manual cock at automatic air vents. Shut after system is free of air.
3. 1/4-inch copper tube discharged into nearest drain.

3.4 FIELD QUALITY CONTROL

A. Test operate valves from closed-to-open-to-closed position while valve is under test pressure.

B. Test automatic valves including solenoid valves, expansion valves, water regulating valves, pressure reducing valves, pressure relief valves, safety valves and temperature and pressure relief valves for proper operation at settings indicated.

C. Ensure that valves are field checked for packing and lubricant and that disc is for service intended. Replace leaking packing at no additional cost to the Owner. Service valves which do not operate smoothly and properly with suitable lubricant before placing in operation at no additional cost to the Owner.

3.5 INSPECTION & COMPLETION

A. Verify that adequate clearance between valves and adjacent walls or equipment is available to permit maintenance and repairs.

B. Verify valve set for normal operation.

C. Valves tags: See Section 230553 – Mechanical Identification.

D. See Section 230593 – Testing, Adjusting and Balancing for HVAC.

END OF SECTION

SECTION 23 05 29 - HANGERS AND SUPPORTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Division 21 - Fire Protection
2. Division 22 - Plumbing Work.

### 1.3 REFERENCE STANDARDS

A. American Society of Mechanical Engineers: ASME Section VIII – Boiler and Pressure Vessel Code – Pressure Vessels.

B. Pipe Supports: ANSI B31.1, Power Piping.

C. Duct Hangers: SMACNA Duct Manuals.

### 1.4 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports".

### 1.5 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Pipe hangers and supports | R | R | | R |
| Structural attachments | R | | | R |
| Pipe protection and thermal hanger shields | R | R | | R |
| Equipment supports | R | | | R |
| Expansion shields | R | | | |
| Welding certificates | R | | | |

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Hangers, Inserts and Supports.

1. Unistrut.
2. Superstrut.
3. B-Line Systems.
4. Or equal.

C. Pipe Protection and Thermal Hanger Shields.

1. Pipe Shields, Inc.
2. Elcen Metal Products Company
3. Superstrut.
4. Or equal.

D. Expansion Shields.

1. Hilti Fastening Systems.
2. ITT Phillips Drill Co.: Red Head.
3. Omark Industries, Inc.
4. Or equal.

E. Pipe Stand Supports.

1. B-Line Systems, Inc.

2. Grinnell Corp.
3. PHD Manufacturing, Inc.
4. Or equal.

F. Powder-Actuated Fastener Systems.

1. Hilti Fastening Systems.
2. ITW Ramset/Red Head.
3. Masterset Fastening Systems, Inc.
4. Or equal.

G. Insulation Protectors.

1. B-Line Systems, Inc.
2. ITT Grinnell Corporation.
3. PHD Manufacturing, Inc.
4. Or equal.

H. Miscellaneous Devices.

1. Kopty.
2. Wejit.
3. Or equal.

## 2.2 PIPE HANGERS AND SUPPORTS

A. Model numbers are Superstrut, unless otherwise indicated.

B. Provide electro-chromate, galvanized or factory painted finish; no plain, "black" hangers allowed.

C. Dielectric Isolators: All un-insulated copper tubing systems; Superstrut isolators or equal, Cush-A-Strip or Cush-A-Clamp on all pipe clamps; for individual hangers, use felt lined hangers.

D. Individual Pipe Hangers.

1. Cold pipe all sizes: Clevis hanger, No. C710.
2. Hot pipe sizes up to 4 in: Clevis hanger, No. C710.
3. Hot pipe sizes above 6 in: Adjustable steel yoke and cast-iron roll No. C729.

E. Multiple or Trapeze Hangers.

1. Factory channel.

a. 12-gauge thick steel.
b. Single or double section.
c. Electro-chromate finish.
d. Strutnuts: Series A-100 or CM-100.
e. Straps: Series 702.
f. No. A-1200 or A-1202.

2. Hot pipe sizes 6 in and larger: cast iron roll and stand; C728 or CR728.

F. Wall Supports.

1. Pipe sizes up to 3 in: Steel bracket No. C738.
2. Pipe sizes 4 in and larger: Welded steel bracket C-735.
3. Hot pipe sizes 6 inches and larger.

    a. Welded steel bracket No. C739.
    b. Adjustable steel yoke and cast-iron roller No.C729.

G. Vertical Support.

1. Riser clamp Series C-720.

H. Floor Support.

1. Hot pipe sizes up to 4 in; cold pipe, all sizes.

    a. Adjustable cast iron saddle No. R786.
    b. Locknut nipple.
    c. Floor flange.

2. Hot pipe sizes 6 in and larger: Adjustable cast iron roll and stand No. R-730-C.

I. Thermal Hanger Shields (for insulated pipe supports).

1. 180-degree high density insert.

    a. 100 psi waterproofed cellular glass, asbestos-free, K=0.38, encased in a 360-degree galvanized sheet metal shield, ASTM A653.
    b. See Section 230719 Piping and Equipment Insulation.
    c. Same thickness as adjoining pipe insulation.

2. 180-degree galvanized sheet metal shield (inverted saddle).

    a. Shield length and gauges.

| Pipe Size | Shield Length | Minimum Gauge |
|---|---|---|
| 1/2-1 1/2 | 4 | 26 |
| 2 - 6 | 6 | 20 |
| 8 - 10 | 9 | 16 |

3. Insert to extend one inch beyond metal shield ends on insulated piping.
4. Use double layer shield on bearing surface for:

    a. Roller hangers.
    b. Support spacing exceeding 10 feet.

J. Pipe Isolators.

1. Hanger with felt padding.
2. Tolco Fig. 3F or equal felt lined hangers.

K. Anchors and Guides: Provide anchors and guides where indicated on the Drawings and as required. Structural inserts shall be high density cellular glass. Guide slide pads shall be Teflon. Ensure that slide accommodates pipe movement over full range of service and out-of-service temperatures. Guides shall be Pipe Shields, Inc. Model #B3000 or equal. Anchors shall be Pipe Shields, Inc. Model #C4000 or equal. See Section 230719 Piping and Equipment Insulation.

L. Insulated Pipe Strap.

1. 1/2 in to 1 in plumbing piping in wood frame construction.
2. Felt insulated.
3. Kopty or equal.

M. Escutcheons: See Section 230500 – Basic Mechanical Materials and Methods.

N. Flashing and Sleeves.

1. Flashings.

a. See Division 7 – Thermal and Moisture Protection.
b. Flash and counter flash watertight all pipe and duct penetrations of roofs and exterior walls.
c. Flash pipes through roofs with ITWBuildex Dektite or equal.
d. Flash vents through roofs with.

1) Minimum 24-gauge soldered roof jack for flat surface roofs.
2) Minimum 4-pound lead soldered roof jack for roofs other than flat surface roofs.
3) Vandal caps.
4) Provide counter-flashing sleeves and storm collars.
5) Caulk counterflashing and storm collar weather tight.
6) Other flashings shall be minimum 24-gauge galvanized sheet metal.

2. Sleeves.

a. See 230500 – Basic Mechanical Materials and Methods.

b. For insulated piping, sleeve diameter shall not be less than diameter of insulation.

c. Terminate sleeves flush with walls, and ceiling.

d. For exposed vertical pipe, extend sleeves 1 inch above finished floor except where escutcheons are required.

e. Packing through fire rated partitions on of following.

1) 3M Penetration Sealing Systems (PSS 7909) and 3M Fire Barrier Caulk and Putty.
2) Dow-Corning LTV Silicone foam.
3) Or equal.

3. Separate piping through walls, other than concrete walls, from contact with wall construction materials; use non-hardening caulking.

4. Install insulation on piping in walls which require insulation at time of installation.

## 2.3 DUCT HANGERS AND SUPPORTS

A. See Section 233113 – Metal Ducts.

## 2.4 STRUCTURAL ATTACHMENTS

A. Model Numbers are Superstrut, unless otherwise indicated.

B. All components shall have galvanized or equal finish.

C. Anchor Bolts: Size as specified for hanger rods.

D. Concrete Inserts.

1. Malleable iron.
2. Place reinforcing steel through insert as recommended by manufacturer for recommended loads.
3. No. 452 or equal.

E. Beam Clamps.

1. All with U-568 safety strap.
2. All with locknuts on.

a. Set Screw.
b. Hanger rod.

3. Bottom flange attachment.

a. Loading 150 pound and less: U-563.
b. Loading 150 pound to 300-pound: U-562.
c. Loading more than 300-pound: U-560.

4. Top flange attachment.

a. Permitted only when bottom flange attachment cannot be used.
b. Loading 400 pound and less: M-777.
c. Loading more than 400-pound: M-778.

F. Welded Beam Attachments: No. C-780 or equal.

G. Side Beam Attachments: No. 542 or equal.

H. Hanger Rods.

1. ASTM A575 Hot rolled steel, galvanized.
2. ANSI B1.1 Unified Inch Screw Treads.
3. Threaded both ends, threaded one end, or continuous threaded.

I. Hanger Rod Fixtures.

1. Turnbuckles: No. F-112 or equal.
2. Linked Eye Rod.

    a. Rod swivel.
    b. No. E-131 or equal.

3. Clevis: No. F-111 or equal.

J. Powder or Gas Actuated Anchors.

1. Not allowed on initial building construction; allowed only for revisions made after initial construction and with approval of Owner.
2. Hardened steel stud with threaded shank; size of shank to match hanger rod size.
3. Use only with non-shock loads.
4. Maximum load safety factors:

    a. Maximum anchor load: 100 pounds.
    b. Static loads – 5.
    c. Vibratory loads - 8-10.

5. For concrete and steel; not to be used for light weight concrete, brick or concrete block.
6. 10% testing rate required, testing by contractor.
7. Omark Drivit or equal.

K. Expansion Shields.

1. Carbon-steel anchors, zinc coated.
2. Stainless steel for corrosive atmospheres.
3. For normal concrete use.

    a. Self-drilling anchor.
    b. Sleeve anchor.
    c. Stud anchor.

4. For thin concrete use: wedge anchor.
5. For brick or concrete block use: sleeve anchor.
6. Maximum load safety factors.

    a. Static loads – 4.
    b. Vibratory loads - 8 – 10.
    c. Shock loads - 8 – 10.

7. Size to suit hanger rods.
8. ITT Phillips Red Head or equal.

L. Steel Deck Inserts.

1. Factory stud with.

a. Clip.
b. Spring.
c. Coupling.

2. ITT Phillips Red-Head or equal.

M. Miscellaneous Metal.

1. Steel plate, shapes, and bars: ASTM A36.
2. Steel pipe columns: ASTM A53, Schedule 40, black.
3. Bolts and nuts: regular hexagon-head type, ASTM A307, Grade A.
4. Lag bolts: square head type, Fed. Spec. FF-B-561.
5. Plain washers: round, carbon steel, Fed. Spec. FF-W.92.

## 2.5 MISCELLANEOUS MATERIALS

A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Structural Steel: ASTM A36/A36M, steel plates, shapes, and bars, black and galvanized.

D. Concrete: Normal weight concrete (145 pcf) using Type I Portland Cement, 1" maximum size coarse aggregate to provide a minimum 28-day compressive strength of 3000 psi.

E. Grout: ASTM C1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.

1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
2. Properties: Non-staining, noncorrosive, and nongaseous.
3. Design Mix: 5000-psi, 28-day compressive strength.

# PART 3 - EXECUTION

## 3.1 PIPE HANGERS, SUPPORTS AND GUIDES

A. General.

1. Assure adequate support for pipe and contents.
2. Provide adjustable hangers for all pipes complete with inserts, adjusters, bolts, nuts, swivels, all-thread rods, etc., except where specified otherwise.
3. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping and do not support piping from other piping.
4. Except as otherwise indicated for exposed continuous pipe runs, install hangers, and supports of same type and style as installed for adjacent similar piping.
5. Install all cast iron piping in accordance with Cast Iron Soil Pipe Industry (CISPI) Standards.
6. Support all piping within 2 feet of each change of direction on both sides of fitting.
7. Thermal hanger shields shall be provided at hangers and supports where piping is insulated.
8. Prevent vibration or swaying.
9. Provide for expansion and contraction.
10. Supports of wire, rope, wood, chain, strap perforated bar or any other makeshift device not permitted.
11. Comply with applicable requirements at ANSI B31.1 and B31.2 for piping.
12. Support piping independently so that equipment is not stressed by piping weight of expansion.
13. Hangers and supports shall have minimum safety factor of five (5), based on ultimate tensile or compressive strength, as applicable, of material used; base calculations on equipment's heaviest operating weight and pipes full of water.
14. Install additional supports or braces if, during normal operation, piping should sway, crawl, or vibrate. Piping shall be immobile.
15. Install thrust blocks as required to prevent sway.

B. Horizontal piping, except as noted.

1. Adjustable clevis type and rod; all services at or below 250 degrees F.
2. Rollers or slide bases: not required.
3. Trapeze hangers; guide individual pipes on trapezes with 1/4-inch U-bolt or Superstrut 702 pipe clamp.

    a. Install thermal hanger shield at each support point.

4. Galvanized sheet metal shields between hangers and PVC piping.
5. Threaded steel rods.

    a. 2 in vertical adjustment with 2 nuts each end for positioning and locking.
    b. Size to 12 inch inside pipe size (IPS).

| Pipe, IPS | Rod |
|---|---|
| to 2-inch | 3/8-inch |
| 2-1/2-inch and 3-inch | 1/2-inch |
| 4-inch | 5/8-inch |
| 6 inch and 8-inch | 3/4-inch |
| 10-inch and 12-inch | 7/8-inch |
| 14-inch and 18-inch | 1-inch |
| 20-inch and 30-inch | 1-1/4-inch |

c. Size above 12-inch IPS and multiple pipe standards: safety factor of 5 on ultimate strength on area.
d. For double rod hangers: 1 size smaller than above.

C. Vertical piping.

1. Base support.

a. Base elbow or welded equivalent.
b. Bearing plate on structural support.

2. Guides.

a. At every third floor but not to exceed.

1) 25 feet for piping to 2-inch.
2) 36 feet for piping 2-1/2-inch to 12-inch.
3) 50 feet for piping 14-inch and larger.

b. Or as otherwise designed by the Vibration Isolation vendor.

3. Top support.

a. Special hanger or saddle in horizontal connection.
b. Provisions for expansion.

4. Intermediate supports: steel pipe clamp at floor.

a. Bolted and welded to pipe.
b. Extension ends bearing on structural steel or bearing plates.

5. For multiple pipes: coordinate guides, bearing plates and accessory steel.

D. Horizontal insulated piping.

1. Install saddles for rollers or slide bases.
2. Install thermal hanger shields for all other types of supports.
3. See Section 230719 Piping and Equipment Insulation for insulation connection to shields.

E. Vertical insulated piping.

1. Install thermal hanger shields at guides.

2. See Section 230719 Piping and Equipment Insulation for insulation connection to shields.

F. Install Pipe Isolators between hangers and piping for all un-insulated copper tubing.

G. Miscellaneous Steel.

1. Provide miscellaneous steel members, beams, brackets, etc., for support of work in this division unless specifically included in other divisions.

H. Fire-stopping.

1. At pipe penetrations through rated assemblies.
2. Commercial pipe sleeve assemblies that are UL listed and that have been approved by the fire marshal for this purpose.

I. Roof pipe supports shall be installed per manufacturer's recommendations in coordination with the roofing system and company holding the roof warranty.

## 3.2 PIPE SUPPORT SPACING

A. Maximum spacing for horizontal piping.

| Type of Pipe | Size | MAXIMUM SPACING |
|---|---|---|
| Steel | 1-1/2 inch and smaller | 7 feet |
| | 2 inch and larger | 10 feet |
| Copper | 3/4 inch and smaller | 5 feet |
| | 1- 1-1/4 inch | 6 feet |
| | 1-1/2 - 3 inch | 8 feet |
| | 4 inch and larger | 10 feet |
| Plastic | 3/4 inch and smaller | 3 feet |

B. Spacing Notes: Additional supports at:

1. Changes in direction.
2. Branch piping and runouts over 5 feet.
3. Concentrated loads due to valves, strainers, and other similar items.
4. At valves 4-inch and larger in horizontal piping, support piping on each side of valve.

C. Parallel piping on trapezes.

1. Maximum spacing to be that of pipe requiring closest spacing.

3.3 ATTACHMENT TO STRUCTURE

A. Concrete.

1. Use inserts for suspending hangers from reinforced concrete slabs, walls, and sides of reinforced concrete beams wherever practicable.
2. Set inserts in position in advance of concrete work.
3. Provide reinforcement rod in concrete for inserts carrying.

    a. Pipe over 4-inch.
    b. Ducts over 60-inches wide.

4. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
5. Where inserts are omitted, install hangers with expansion shields.
6. Through-deck support.

    a. Drill through concrete slab from below.
    b. Provide rod with recessed square steel plate and nut above slab.

7. Where permitted by Owner and only for revisions made after initial construction, powder actuated anchors or expansion shields may be used in lieu of inserts.

    a. In bottom of thick slabs.
    b. In thin slab construction, only in sides of beams.

8. Pre-Cast Concrete.

    a. Use pre-set inserts.
    b. Where inserts are not available, field drill through beam or joists at locations as directed by Architect.
    c. Through bolt side beam bracket to beam or joist.

9. Poured-In-Place Concrete.

    a. With metal form or under-deck.
    b. Before concrete is poured.

        1) Field drill hole through metal deck.
        2) Provide bearing plate, nut, and locknut on rod; or install factory-made steel deck inserts specified hereinbefore.

    c. After concrete is poured.

        1) Install hangers with expansion shields.

B. Steel Beam Anchors.

1. Beam or channel clamps.

2. Do not cut or weld to structural steel without permission of structural engineer.

C. Steel Deck Anchors.

1. Concrete filled: as specified above.
2. Decking without concrete.

a. Through rod Support.

1) Weld to square plate, 1/4 in thick.
2) Plate to distribute load over minimum of two full cells.
3) Coordinate with floor layouts to clear cells with wiring.

D. Side Wall Supports.

1. Concrete walls: As specified for hangers.
2. Stud Walls.

a. Toggle bolts.
b. Stud welded to structural studs.

E. Support Spreaders.

1. Install spreaders spanning between structural members when hangers fall between them, and hanger load is too great for slab or deck attachment.
2. Spreaders may be one of methods listed below, or combination of both as required.

a. Fabricated from structural channel.

1) End fittings bolted or welded.
2) Secure to structural members.

a) As required by construction.
b) As reviewed by Structural Engineer.

b. Formed channels with fittings, Superstrut or equal.

1) Submit manufacturer's calculations for installation.

## 3.4 DUCT HANGERS AND SUPPORTS

1. See Section 233113 Metal Ducts.

## 3.5 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and floor pipe supports. Finish shall provide a smooth bearing surface.

## 3.6 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes 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 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 contours of welded surfaces match adjacent contours.

## 3.7 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 1-1/2-inches.

## 3.8 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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 05 53 – MECHANICAL IDENTIFICATION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Equipment nameplates.
2. Access panel and door markers.
3. Pipe markers.
4. Duct markers.
5. Valve tags.
6. Valve schedules.

### 1.3 REFERENCE STANDARDS

A. Pipe marker shall comply with ANSI A13-1.

### 1.4 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Pipe markers | R | | R | |
| Duct markers | R | | R | |
| Equipment tags | R | | R | |
| Valve tags | R | | R | |
| Concealed equipment markers | R | | R | |
| Equipment label and valve tag schedule | | R | | |
| Valve numbering scheme | | R | | |
| Valve schedules | R | R | R | |

1.5 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.6 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

1. Brimar Industries, Inc.
2. Seton Identification Products.
3. Marking Services, Inc.

2.2 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Labels:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg. F.
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: Principal lettering shall be 1/2 inch. 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. 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.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-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.

## 2.3 ACCESS PANEL AND DOOR MARKERS

A. Access panel and access door markers:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Red.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg. F.
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: Principal lettering shall be 3/4 inch. 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. Label access panels and access doors identifying “Fire Damper, Fire/Smoke Damper”, etc.

## 2.4 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or shaped pipe markers at least three times letter height and of length required for label.

B. Pretensioned Pipe Labels: Pre-coiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. 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: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

## 2.5 DUCT LABELS

A. Not required.

## 2.6 VALVE TAGS

A. Valve Tags: Numbering scheme approved by Architect.

1. General: Identify valves with metal tags, legends to be stamped or embossed. It shall indicate the function of the valve and its normal operating position; such as:

a. "56 HW" (NUMBER AND CONTENT OF PIPE)
b. "ISOLATION" (VALVE FUNCTION)
c. "NC" (NORMALLY CLOSED)

B. Description: 2-inch diameter stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain or S-hook.
3. Automatic Valves and Regulating Valves: Use 1/16-inch thick laminated 3-ply plastic, center ply white, outer ply red, "lamicoid" or equal. Form letters by exposing center ply.
4. Valve Tag Directory: Include tag number, location, exposed or concealed, service, valve size, valve manufacturer, valve model number, tag material, and normal operating position of valve.

C. Valve Schedules: For each piping system, on plastic laminated, standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Include floor plan location drawing with all valves indicated with the valve tag assigned to each valve. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule and Valve Floor Plan Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

## 2.7 EQUIPMENT LOCATOR TACKS

A. 7/8" diameter tack for pushing into ceiling tile near closest equipment access point. Colors to be as specified.

# PART 3 - EXECUTION

## 3.1 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.

## 3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

## 3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment (including motor starters, VFDs, control panels, etc.)

B. Locate equipment labels where accessible and visible.

C. Install access panel markers with screws on equipment access panels.

## 3.4 PIPE LABEL INSTALLATION

A. 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. Within 18” of each valve, valve assembly and control device.

2. Within 3’ of each 90-degree elbow, connection to equipment or vessel and where pipe enters shafts and penetrates outside walls, floors, ceilings and non-accessible enclosures.
3. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
4. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
5. At access doors, manholes, and similar access points that permit view of concealed piping.
6. Near major equipment items and other points of origination and termination.
7. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
8. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:

| Service | Pipe marker | Background color | Lettering |
|---|---|---|---|
| Loop/condenser water | Condenser water supply | Green | White |
| | Condenser water return | Green | White |
| Refrigerant Suction/Gas | Refrigerant Suction/Gas | Orange | Black |
| Refrigerant Liquid | Refrigerant Liquid | Orange | Black |
| Cold water | Domestic cold water | Green | White |
| Hot water | Domestic hot water supply | Yellow | White |
| | Domestic hot water return | Yellow | White |
| Sanitary waste | Sanitary waste | Green | White |
| Storm drain | Storm drain | Green | White |
| Condensate drain | Condensate drain | Green | White |
| Vent | Vent | Green | White |

## 3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape: 1-1/2 inches, round.

2. Valve-Tag Colors:

   a. Potable and loop/condenser Water: White letters on a safety-green background.
   b. Hot and Heating Water: White letters on a safety-orange background.
   c. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

## 3.6 VALVE SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

## 3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

## 3.8 EQUIPMENT LOCATOR TACKS

A. Install tacks into the ceiling tile or insulation at the closest access point to the device.

B. Install tacks to locate above ceiling equipment and devices as follows:

1. Fire dampers (red).
2. Manual volume dampers (orange).
3. Motorized control dampers (yellow).
4. HVAC equipment (black).
5. Hydronic system valves (green).
6. Control system devices (light blue).
7. Cold water (blue).
8. Hot water (red).

## 3.9 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

## 3.10 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION

# SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Operational testing and adjusting of air handling equipment.
b. Balancing of air distribution systems.
c. Testing and adjustment of air terminal devices.

2. Balancing Hydronic Piping Systems:

a. Flow testing and adjusting of hydronic systems.

3. Testing, adjusting, and balancing existing systems and equipment.
4. Witnessing and certification of duct air leakage tests.

### 1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

### 1.4 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| AABC or NEBB certification | R | | | |
| Report forms | R | | | |
| List of instrumentation | R | | | |
| Final air balancing report | | R | | |
| Final water balancing report | | R | | |

C. Final Test & Balance Report.

1. At least 15 days prior to Contractor's request for final inspection, submit electronic copy of final reports on approved reporting forms for review and approval by Architect. Once approved, provide required quantity of paper and electronic copies per 230010 "Mechanical General Provisions."
2. Form of final reports.

    a. Fully completed report forms for all systems specified to be tested and balanced including at a minimum all data specified herein to be recorded.
    b. Each individual final reporting form must bear:
    c. Identify instruments of all types that were used and last date of calibration of each.

1.5 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.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. Prior to start of testing, adjusting, and balancing, verify that required Project conditions are met:

1. System and control system installation is complete and in full operation.
2. All pre-functional tests have been performed.
3. Equipment has been started and tested in accordance with manufacturer's installation instructions.
4. Doors and windows are in place and closed or under normal traffic conditions.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

## 1.6 PROJECT REVIEW

A. Construction Review.

1. Make on-site visits during progress of construction: Number of visits to be as required to perform the functions specified below.
2. Purpose of review.

    a. Identify potential problem for performing total system balance.
    b. Identify modifications that will affect air total system balance.
    c. Schedule and coordinate total system balance with other work.
    d. Identify conditions that could create hazardous environment for building occupants.

3. Typical activities.

    a. Check that necessary balancing and measuring hardware is:

        1) In place.
        2) Located properly and accessibly.
        3) Installed correctly.

    b. Identify and evaluate variations from system design.
    c. Record data from equipment nameplates.
    d. Identify and report possible restrictions in systems; such as:

        1) Closed fire dampers.
        2) Long runs of flexible duct.
        3) Poorly designed duct fittings.
        4) Questionable piping connections.
        5) Others as may arise or based on Agency’s experience.

    e. Verify that construction progress will not delay total system balance.
    f. Identify best location for duct Pitot tube traverses.
    g. Identify scaffolding needs.

# PART 2 - PRODUCTS

## 2.1 TEST EQUIPMENT

A. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified herein. If not otherwise noted, the following minimum requirements apply.

1. Volt-meter: plus or minus 1 percent scale.
2. Ammeter: plus or minus 1 percent scale.
3. Ohmmeter: plus or minus 0.1 percent scale for calibrating plus or minus 0.4 degrees Fahrenheit resistance temperature sensors, plus or minus 0.25 percent scale for calibrating plus or minus 1 degrees Fahrenheit temperature sensors, plus or minus 1 percent scale for measuring motor current.
4. Ultrasonic time-of-travel strap-on flow sensor: plus or minus 5 percent of reading.
5. Other flow sensors: plus or minus 2 percent of reading.
6. Water pressure gauge: plus or minus1/2 percent scale, ASME Grade 2A.
7. Watt meter, plus or minus1/2 percent scale: 3 phase split core current transducers.
8. Temperature: plus or minus 0.4 degrees Fahrenheit.

B. All equipment shall be calibrated within 6 months of use, or according to the manufacturer's recommended interval, whichever is shorter, and when dropped or damaged. Calibration tags shall be affixed or certificates readily available and proof of calibration shall be included reports.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Coordinate with work of other trades.

B. Report to Professional any discrepancies or items not installed in accordance with the Contract Drawings pertaining to proper balance and operation of air and water distribution systems.

C. Perform testing, adjusting, and balancing in accordance with AABC or NEBB standards.

D. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to Section 230713 "Duct Insulation" and Section 230719 "Piping and Equipment Insulation.".

E. Mark equipment settings with paint or other suitable, permanent identification material, including damper control positions, valve indicators, and similar controls and devices, to show final settings.

### 3.2 CONTROL SYSTEM COORDINATION

A. See Section 230900 "Energy Management & Control Systems-General (EMCS)."

B. System balance techniques in this Section rely on the operation of the EMCS. Test and balance agency shall coordinate schedule of work with EMCS installer to ensure test and balance work can be executed and completed in a timely manner.

C. Cooperate with EMCS installer in determining operating conditions and setpoints, as indicated in this Section.

D. Cooperate with EMCS installer in calibrating all airflow measuring devices.

E. Obtain and receive training for required software from controls system vendor for setting calibration constants in terminal devices.

## 3.3 AIR SYSTEMS BALANCING

A. General.

1. Do not operate fan systems for test or balance until spaces served have been cleaned of dust and debris, to avoid contamination of supply air or return air paths and equipment.
2. Filters.

    a. Check that filters are installed, oriented in the proper airflow direction, free of bypass, and clean.
    b. Make no adjustment for dirty filters, fans were selected for clean filters at design airflow.

3. In cooperation with EMCS installer, set adjustments of automatically operated dampers and valves to operate as indicated.
4. Balance hydronic systems prior to air balance and have operational during air balance for air temperature measurements.

B. Air Outlets.

1. Adjust diffusers' throw pattern, grilles and registers to pattern indicated on the Drawings. Review manufacturer's instructions for proper diffuser blade or weir gate positions to provide this throw pattern as it is not always intuitive. It is TAB agency's responsibility to adjust throw patterns for all adjustable throw diffusers. If diffuser has a fixed throw pattern and is incorrectly installed, HVAC contractor shall correct pattern prior to balance.

    a. Ceiling diffusers: As indicated on the Drawings.

        1) Star pattern diffuser deflectors shall be adjusted for corner blow pattern unless otherwise indicated on Drawings.

    b. Double-deflection grilles: Adjust rear blades horizontal 22 degree upward and splay front blades in 45-degree pattern at each end gradually rotating to almost straight at blades in center of grille.

c. Floor grilles: Not applicable.

2. Test and adjust each diffuser, grille and register to within plus or minus 10 percent of design requirements.

a. Start with all dampers wide open.
b. Adjust dampers, starting with nearest to terminal unit or fan. Make adjustments using duct mounted volume dampers rather than dampers at diffuser face, (if any) unless absolutely required.
c. At least one damper shall remain wide open at end of balance.

3. Plenum return air grilles or slots in lights: No balance required.
4. Report.

a. Tag each grille, diffuser and register and mark tag on copy of floor plan.
b. For each grille, diffuser, and register, indicate tag, size, type, and effective area (where applicable).
c. Required velocity/cubic feet per minute.
d. Initially tested velocity/cubic feet per minute.
e. Finally tested cubic feet per minute after adjustments.

C. Water Source Heat Pumps, Fan Coil Units, Package Equipment.

1. Total air quantities shall be obtained within 10 percent of design by adjustment of fan speed.

a. Adjust sheaves on fans with adjustable sheaves.
b. Change sheaves on fans with fixed sheaves.
c. Adjust speed potentiometer for EC motors.
d. Adjust SCR for direct drive PSC motors.

2. Test and adjust minimum outdoor air flow.

a. Supply air fan shall first be operating at design airflow.
b. For systems with economizers.

1) Open return air damper fully.
2) Adjust the outdoor air damper signal through the EMCS until the minimum outdoor airflow rate is achieved.
3) Convey this minimum signal to EMCS installer and note on air balance report.

c. For systems without economizers.

1) Adjust minimum outdoor air or return air damper balancing damper position or linkage to deliver design minimum outdoor airflow rate.
2) Clearly mark minimum damper position on damper housing.

3. Test with system operating at minimum outside air flow condition described above and record the following on a schematic of the system.

a. Tag.
b. Manufacturer and model of fan and motor.
c. Sheave data at motor and fan; belt data.
d. Motor horsepower, rpm, volts, phase, FLA.
e. Fan airflow rate at all locations measured, as listed above.
f. Final measured amps.
g. Static pressure measured at:

1) Return air plenum.
2) Mixed air plenum.
3) Downstream of filter.
4) Downstream of coil.
5) Discharge of fans.

h. Concurrent airflow rate readings from EMCS airflow sensors, where applicable.
i. Minimum EMCS outdoor air control signal, where applicable.

D. Exhaust Fans.

1. See herein for air outlet balancing.
2. Total air quantities for fan shall be determined by both:

a. Pitot tube traverse of main ducts near the fan inlet, and.
b. Totaling the readings of individual air outlets (or inlets).

3. Total air quantities shall be obtained within 10 percent of design by adjustment of fan speed.

a. Constant speed fans:

1) Adjust sheaves on fans with adjustable sheaves.
2) Change sheaves on fans with fixed sheaves.
3) Adjust speed potentiometer for EC motors.

b. Variable speed fans:

1) Adjust maximum fan speed at ECM or VFD.

4. Report.

a. Tag.
b. Manufacturer and model of fan and motor.
c. Sheave data at motor and fan; belt data.
d. Motor horsepower, rpm, volts, phase, full load amps.
e. Fan airflow rate at all locations measured, as listed above.
f. Final measured amps.
g. Inlet and outlet static pressure.

## 3.4 WATER SYSTEMS BALANCING

A. Prepare water systems for balancing in following manner.

1. Verify the following conditions:

a. Piping systems have been flushed and treated in accordance with Section 232113 "Hydronic Piping."
b. Strainers have been cleaned.
c. Piping systems are completely full of water, all air properly vented.
d. All coil and heat exchanger isolation shut-off and balance valves are fully open.

2. Check Pump.

a. Rotation.
b. Pump factory impeller trimming by comparing shut-off heads with pump curves from approved submittals.

1) Note that impellers on variable speed pumps should not be trimmed to design flow and head conditions. See 232123 "Hydronic Pumps."
2) Report discrepancy in shut-off head to Architect and if impeller does not appear to be properly trimmed, wait for direction before proceeding with pump test and balance.

3. EMCS and Central Plant Operability.

a. Do not proceed with any of the following balancing procedures until the EMCS is capable of operating equipment such as fans, pumps, VAV boxes, control valves, and the like, in manual and automatic modes and capable of reading sensors such as differential pressure, flow rates, temperatures, and the like, of air and hydronic systems to be tested and adjusted.
b. Do not proceed with air handler and fan-coil testing until chilled and hot water at design temperatures are available from the central plant.

B. Pumps.

1. Test and report for each pump at test conditions indicated in Paragraphs below.

a. Tag.
b. Manufacturer and model of pump and motor.
c. Motor horsepower, volts, phase, full load amps.
d. Pump shut-off head from curves, measured shut-off head, and resulting impeller diameter from pump curve.
e. At test condition specified.

1) Volts and amps.
2) Calculated brake horsepower.
3) Entering and leaving gauge pressure and difference in feet.
4) Flow rate deduced from pump curve.
5) For pump with VFD:

a) Speed (Hz).
b) Kilowatts.

C. Heating Water and Chilled Water Distribution System.

1. Coil Test & Balance.

a. System is self-balancing. Two-way control valves at coils prevent each coil from being over-supplied with water, other than minor excursions during transients such as cool-down or warm-up. Conventional balancing (throttling of balancing valves) will increase pump energy use by not allowing aggressive differential pressure setpoint reset. Hence, do not adjust any valves on any coil or pump, except temporary adjustments where noted. Calibrated balancing valves may be provided for flow measurement and diagnostics but they shall not be modulated for flow balancing. All manual valves at coils and pumps shall be wide open when test and balance work is complete.

b. Report with all control valves open to coil and all pumps (except standby pumps, where applicable) operating at full speed.

1) See Air Balance below for coil temperature data.
2) See Pump test data above for pump data.
3) Coils with modulating two-way or three-way control valves.

a) Terminal tag.
b) Control valve model number and serial number.
c) Pressure drop across coil.
d) Flow as measured by calibrated balancing valve (where applicable).

2. Control Valve Shut-Off Test.

a. Close all control valves in the system through the EMCS. Close bypass balance valves of 3-way valves (where applicable). Run all pumps (except stand-by pump, if any) at full speed:

1) Verify that all control valves remain shut with no measurable flow, as indicated by pump differential pressure, flow meters, and any temperature rise across coils.
2) Do not run pumps deadheaded for more than 5-minutes at any one time.
3) After test, return 3-way valve balance valves to prior position and release control valves to automatic operation through the EMCS.

b. Report at condition described above.

1) Tag of coils where flow is detected. Initials of EMCS contractor to indicate that this information was transmitted to them.
2) Measured pump inlet and outlet pressures, and difference converted to feet.

3) Differential pressure reading at all differential pressure sensors, through EMCS.
4) Water flow rate from flow meter, through EMCS.

## 3.5 TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

## 3.6 DUCT AIR LEAKAGE TESTS

A. TAB Agency shall witness duct air leakage tests once Division 23 HVAC contractor confirms in writing that all ductwork has passed the pretest.

B. TAB Agency shall initial Duct Air Leakage Test Log for each section of duct tested certifying that duct passed the maximum permitted air leakage test as specified in Section 233113 – Metal Ducts.

## 3.7 SPOT CHECKING

A. Spot checks shall take place after test and balance work is complete and reports have been prepared and approved.

B. Spot checks shall be witnessed by a Professional. Schedule spot checks with Professional at least 1 week prior to proposed test date.

C. Professional shall select subsets of any tested and balanced air or hydronic system to be spot-checked on the day of tests without prior notice to the Contractor.

1. Spot-checking will not require more than one working day.
2. If additional spot checks are requested by the Professional causing the time limit above to be exceeded, inform Professional and indicate added price to perform the additional tests. Do not include additional tests in initial bid.

D. Discrepancies.

1. If any of the spot-check measurements differ more than 25 percent from those documented in test and balance reports, the Agency shall completely rebalance the associated system. For balance discrepancies at or downstream of a VAV box, rebalance only is required at or downstream of that box.
2. If discrepancies as described above are found on more than 25 percent of the spot-checks for air systems, all air systems shall be rebalanced.
3. If discrepancies as described above are found on more than 25 percent of the spot-checks for hydronic systems, all hydronic systems shall be rebalanced.
4. Rebalance work shall be witnessed by the Architect at the option of the Architect.
5. All rebalance work shall be documented, and documentation shall be resubmitted as specified above.
6. All rebalance work shall be provided at no additional cost to the Owner.

## 3.8 TRAINING OWNER PERSONNEL

A. Go over the final Testing, Adjusting and Balancing Report, explaining the layout and the meanings of each data type.

B. Discuss any outstanding deficient items in control, ducting, piping, or design that may affect the delivery of air or water.

C. Identify and discuss any systems or system components that are not meeting their design capacities.

D. Discuss any temporary settings and steps to finalize them for any areas that are not finished or fully occupied.

E. Any other appropriate points that may be helpful for facilities operations, relative to testing, adjusting, and balancing or the mechanical systems.

END OF SECTION

SECTION 23 07 13 - DUCT INSULATION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Ducts and plenums, thermal insulation.
2. Duct liner.

B. Related Sections:

1. Section 230719 Piping and Equipment Insulation.

### 1.3 REFERENCE STANDARDS

A. ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM C177 – Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

C. ASTM C335 – Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

D. ASTM C585 – Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe.

E. ASTM C921 – Properties of Jacketing Materials for Thermal Insulation.

F. ASTM E84 – Surface Burning Characteristics of Building Materials.

G. ASTM E96 – Water Vapor Transmission of Materials.

H. NFPA 255 – Surface Burning Characteristics of Building Materials.

I. SMACNA – HVAC Duct Construction Standards - Metal and Flexible.

J. UL 723 – Surface Burning Characteristics of Building Materials.

K. ASTM E 814 – Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

1.4 DEFINITIONS

A. Duct Dimensions.

1. Duct sizes indicated on Drawings shall be clear inside dimensions unless duct size is specifically indicated as outside dimensions (OD).

1.5 QUALITY ASSURANCE

A. Source Quality Control.

1. Service: Use insulation specifically manufactured for service specified.
2. Labeling: Insulation labeled or stamped with brand name and number.

B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Ductwork Mockups:

a. One 10-foot section each of rectangular and round straight duct.
b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
d. One rectangular and round transition fitting.
e. Four support hangers for round and rectangular ductwork.
f. Each type of damper and specialty.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

1.6 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Duct insulation, wrap and liner | R | | | |
| Jackets | R | | | |
| Adhesives and coatings | R | | | |
| Mechanical fasteners | R | | | |
| Installer qualifications | R | | | |

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Insulation: fiberglass.

1. Owens-Corning Fiberglass Corporation.
2. Johns Manville.
3. Certainteed Corporation.
4. Knauf.
5. Or equal.

C. Adhesives.

1. Childers Brand; H. B. Fuller Construction Products.
2. Foster Brand; H. B. Fuller Construction Products.
3. Mon-Eco Industries, Inc.
4. Or equal.

D. Mechanical Fasteners.

1. AGM Industries, Inc.
2. Miracle Adhesives Corporation.
3. Grip-Nail.
4. Or equal.

2.2 GENERAL

A. Energy Codes: The current versions of ASHRAE 90.1 shall govern where requirements for thickness exceeds thickness specified.

B. All insulation materials, including jackets, facings, adhesives, coatings, and accessories are to be fire hazard rated and listed by Underwriters' Laboratories, Inc., using Standard UL 723 (ASTM E-84), (NFPA-255), (ASA A2.5-1963).

1. Flamespread: maximum 25.
2. Fuel contributed and smoke developed: maximum 50.
3. Flameproofing treatments subject to deterioration from moisture or humidity are not acceptable.

C. Insulation and accessories shall not provide any nutritional or bodily use to fungi, bacteria, insects, rats, mice, or other vermin, shall not react corrosively with equipment, piping, or ductwork, and shall be asbestos free: Duct lining shall meet ASTM C1136 and ASTM C665 for biological growth in insulation

2.3 MATERIALS

A. Duct Wrap with Vapor Barrier, Type DW-V.

1. Insulation: ASTM C553 and C612; flexible, noncombustible blanket.

a. Installed 'K' ('Ksi') value: ASTM C518, 0.27 at 75 degrees Fahrenheit.
b. Maximum service temperature: ASTM C411, 250 degrees Fahrenheit.
c. Maximum moisture absorption: 0.20 percent by volume.

2. Vapor Barrier Jacket - factory installed. (FSK).

a. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
b. Moisture vapor transmission: ASTM E96 Procedure E; 0.02 perm.
c. Secure with pressure sensitive tape.

3. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.

a. Flexible fiberglass wrap

1) Supply Air: 2.2” Nominal Thickness with Installed R-Value 6.0 (0.75 pcf)
2) Return/Outside/Exhaust Air: 1.5” Nominal Thickness with Installed R-Value 4.2 (0.75 pcf)

b. Installed conductance: 0.27 BTU-inch/hr/square foot/degree Fahrenheit.
c. Factory applied jacket.

1) Foil-scrim-kraft laminate: Aluminum foil facing.
2) Glass scrim reinforcing.
3) Kraft paper backing.

d. Maximum vapor permeance: 0.02 perms

4. Owens-Corning All Service Faced Duct-Wrap or equal.

B. Duct Board with Vapor Barrier, Type DB-V

1. Insulation: ASTM C612; rigid, noncombustible board.

a. 'K' ('Ksi') value: ASTM C518, 0.23 at 75 degrees Fahrenheit.
b. Maximum service temperature: 350 degrees Fahrenheit.
c. Maximum moisture absorption: 0.20 percent by volume.

2. Vapor Barrier Jacket - factory installed (FSK).

a. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
b. Moisture vapor transmission: ASTM E96 Procedure E; 0.02 perm.
c. Secure with pressure sensitive tape.

3. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.
4. Installed conductance: 0.23 BTU-inch/hr/square foot/degree Fahrenheit.
5. Thickness per Duct Insulation Type and Thickness Schedule.
6. Factory applied jacket.

a. Foil-scrim-kraft laminate.

1) Aluminum foil facing.
2) Glass scrim reinforcing.

C. Rectangular Duct Liner, Type AL.

1. Material.

a. Insulation: ASTM C423.
b. 'K': ASTM C518, 0.23 at 75 degrees Fahrenheit.
c. Maximum service temperature: 350 degrees Fahrenheit.
d. Maximum moisture absorption: 0.20 percent by volume.
e. Thickness per Duct Insulation Type and Thickness Schedule.
f. 1-1/2 pounds per cubic foot unless shown otherwise to be 3 pounds per cubic foot.
g. Installed conductance: 0.25 BTU-inch/hr/square foot/degree Fahrenheit.

2. Interior air side surface.

a. Smooth black neoprene or matte facing overlay on air side. Coating shall conform to NFPA 90A, ASTM C665, ASTM G21.
b. Suitable for velocity up to 4000 feet per minute.
c. Meet erosion test method described in UL publication No. 181.

d. Durable and mechanically cleanable.
e. EPA registered anti-microbial agent.
f. Certainteed Toughgard Duct Liner or equal.
g. Adhesives.

1) Duct Insulation, Internal: Foster 85-60 or equal.
2) Weld Pins: Duro-Dyne CP or equal.

D. Round Duct Liner, Type RAL.

1. Same material as Type AL.
2. Interior air-side surfaces same as Type AL.
3. Self-supporting, slide-in installation.
4. Schuller Permacote Spiracoustic or equal.
5. Small diameter ducts which cannot be insulated internally using duct lining materials shall be prefabricated. Insulation material shall be fixed between outer duct metal and a perforated metal liner. United McGill k27 series or equal. Fittings shall be insulated to same standard and shall be by same manufacturer.

E. Plenum Liner, Type PL

1. Material.

a. Heavy-density mat-faced Plenum Liner: Comply with ASTM C 1071.
b. 'K': ASTM C518, 0.23 at 75 degrees Fahrenheit.
c. Maximum service temperature: 350 degrees Fahrenheit.
d. Maximum moisture absorption: 0.20 percent by volume.
e. Thickness per Duct Insulation Type and Thickness Schedule.
f. 1-1/2 pounds per cubic foot unless shown otherwise to be 3 pounds per cubic foot.
g. Installed conductance: 0.25 BTU-inch/hr/square foot/degree Fahrenheit.

2. Interior air side surface.

a. Smooth black neoprene or matte facing overlay on air side. Coating shall conform to NFPA 90A, ASTM C665, ASTM G21.
b. Suitable for velocity up to 4000 feet per minute.
c. Meet erosion test method described in UL publication No. 181.
d. Durable and mechanically cleanable.
e. EPA registered anti-microbial agent.
f. Knauf Insulation Rigid Plenum Liner or equal.
g. Adhesives.

1) Duct Insulation, Internal: Foster 85-60 or equal.
2) Weld Pins: Duro-Dyne CP or equal.

## 2.4 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Duct Board, Type FB:

1. Structural-grade, press-molded, xonolite calcium silicate.

2. Fireproofing board suitable for operating temperatures up to 1700 deg. F.
3. Comply with ASTM C 656, Type II, Grade 6.
4. Tested and certified to provide a 1 or 2-hour fire rating (as required by application) by an NRTL acceptable to authorities having jurisdiction.
5. 3M Fire Barrier Duct Board or equal.

B. Fire-Rated Duct Wrap, Type FW:

1. High-temperature, flexible, blanket insulation with FSK jacket.
2. Tested and certified to provide a 1 or 2-hour fire rating (as required by application) by an NRTL acceptable to authorities having jurisdiction.
3. 3M Fire Barrier Duct Wrap or equal.

## PART 3 - EXECUTION

### 3.1 DUCT & PLENUM INSULATION

A. Duct Insulation Type and Thickness Schedule.

| Location | Cooling or Heat/Cool Supply | Return/Outdoor Air | Exhaust |
|---|---|---|---|
| Concealed in ceiling or return air plenum | 2.2 inches DW-V | 1-1/2 inches DW-V | 1-1/2 inches DW-V |
| Concealed in unconditioned spaces | 2.2 inches DW-V | 1-1/2 inches DW-V | 1-1/2 inches DW-V |
| Exposed within mechanical rooms | 2.2 inches DW-V | 1-1/2 inches DW-V | 1-1/2 inches DW-V |
| Lined duct on drawings (unless otherwise noted) | 1 inch 1.5 pounds per Cubic foot AL or RAL | 1 inch 1.5 pounds per Cubic foot AL or RAL | 1 inch 1.5 pounds per Cubic foot AL or RAL |
| Transfer air ducts | 1 inch 1.5 pounds per Cubic foot AL or RAL | 1 inch 1.5 pounds per Cubic foot AL or RAL | 1 inch 1.5 pounds per Cubic foot AL or RAL |
| Terminal cans | 0.5 inches 1.5 pounds per cubic foot AL | 0.5 inches 1.5 pounds per cubic foot AL | - |
| Flex duct | By manufacturer | By manufacturer | - |
| Double wall duct | 1 inch 1-1/2 pounds Per cubic foot DW | - | - |

| Location | Cooling or Heat/Cool Supply | Re-turn/Outdoo r Air | Exhaust |
|---|---|---|---|
| Air distribution devices, not factory insulated (backpans of grilles, registers, and diffusers) | 2 inches DW-V | - | - |

3.2 NON-INSULATED DUCTWORK

A. No insulation required for ducts so indicated in Duct Insulation Type and Thickness Schedule, and the following:

1. Factory-insulated flexible ducts.
2. Factory-insulated plenums and casings.
3. Flexible connectors.
4. Vibration-control devices.
5. Factory-insulated access panels and doors.

3.3 DUCT INSULATION INSTALLATION

A. General.

1. Ensure that insulation is continuous through all walls.
2. Finish insulation neatly at hangers, supports and other protrusions.
3. Locate insulation joints or cover seams in least visible locations.
4. Where ducts run in groups too close to be individually insulated and finished.

    a. Completely fill all spaces between ducts with rigid or flexible insulating material.
    b. Insulate and finish exterior surfaces of group as specified for particular service.

5. Where ducts cannot be insulated after erection, insulate prior to installation.
6. Where specified thickness of insulation and/or lining exceeds available thickness in single layer, provide insulation and/or lining in 2 or more layers with joints staggered.
7. Preparation:

    a. Do not install covering before ductwork and equipment has been tested and reviewed.
    b. Ensure surface is clean and dry prior to installation.
    c. Ensure insulation is dry before and during application.

8. Mechanical fasteners:

    a. Use spot weld anchors in all shop fabricated internally lined ducts.
    b. Adhered anchors.

c. Clip off pin penetrations flush with insulation surface or facing.
d. Seal pins and washers where pins penetrate vapor barriers.

1) With 4-inch square pieces of vapor barrier material to match facing.
2) Adhere with vapor-seal adhesive.

e. Spacing on rectangular ducts.

1) Typical of horizontal and vertical, unless otherwise specified.
2) Duct board.

a) 3 inches in from edges.
b) Intermediate fasteners: 12 inches on counter maximum spacing all directions.
c) Not less than four pins per surface.

3) Duct Wrap.

| Side Dimension | Maximum Spacing |
|---|---|
| 24 inches and under | None required. |
| 25 to 32 inches | Horizontal - none. Vertical: 1 row centered, 12 inches on center |
| 33 to 48 inches | 2 rows, 12 inches on center. |
| 49 to 60 inches | 3 rows, 12 inches on center. |
| 61 inches and over | 16 inches on center, all directions. |

4) Duct wrap spacing applicable to flat surfaces of flat oval ducts.

9. Provide 24-gauge sheet metal Z section frames over edges of duct and plenum lining.

a. At access openings and doors.
b. Along edges exposed to air flow.

B. Rectangular Duct Wrap.

1. Vapor barrier and sealing continuous without breaks. Vapor proof seal around supports and bracing.
2. 2 inches lap strip at one end.
3. Peel insulation for 2-inch lap strip along longitudinal joints.
4. Seal lap strips with vapor-seal adhesive; Foster's 85-60 or equal.

C. Round Duct Wrap.

1. Adhere flexible insulation to ductwork with adhesive applied in 6-inch wide strips on 16 inch centers.
2. Provide 16-gauge annealed tie wire tied, spiral wound or half hitched at 16-inch centers.
3. Overlap insulation 2 inches and seal joints and breaks with 2-inch lap of foil adhered over joint.
4. Apply duct wrap with vapor barrier as specified above for rectangular ducts.

D. Duct Board.

1. Comply with published recommendations of manufacturer.
2. Secure on top, sides and bottom of duct with mechanical fasteners, spacing as scheduled.
3. Secure with 4-inch strips of adhesive, 8 inch on center.

E. Rectangular Duct and Plenum Lining.

1. Comply with SMACNA Duct Liner Application Standard, published recommendations of manufacturer, and following:
2. Apply adhesive over 100 percent of surfaces to be lined.
3. The coated surface shall face air stream.
4. Surface adjacent to air flow, including at joints, to be uniformly flat.
5. Insulation on floors of plenums and large ducts where access is required shall be protected by wire mesh so that lining is not damaged when walked or crawled on.
6. Blank-Off Panels: Insulation, enclosed with sheet metal on all sides; all joints with vapor barrier mastic and taped.
7. Volume Dampers: Where volume dampers do not allow for continuous insulation, terminate insulation clear of handle sweep and finish edges to maintain vapor barrier and to prevent damage to the insulation.
8. Seal butt joints and exposed edges of liner to prevent erosion.
9. Edges at terminal points shall be provided with metal beading and heavily coated with adhesive.
10. Damaged areas replaced or heavily coated with adhesive.
11. Mechanical fasteners.

    a. Use weld pins.
    b. Install mechanical fasteners.

        1) Weld pins flush with liner surface. Weld pins spaced maximum of 12-inch on center in both directions and within 2 inches of all corners and joints, except where SMACNA Standard requires closer spacing.
        2) Within 2 inches of all edges.
        3) Minimum 4 pins per side.
        4) For field alterations of lined ducts, install adhesive and glued pins with washers. Clip-off pins after washers installed. Field installed pins shall be used for unusual conditions only and shall not exceed 1 percent of total pins.

3.4 PENETRATION THROUGH RATED WALLS

A. Refer to drawings for penetrations of rated assemblies.

B. Install per manufacturer's installation and listing requirements.

3.5 FIELD QUALITY CONTROL

A. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

B. All vapor barriers shall be continuous; tears, holes, staples, etc. shall be coated with vapor barrier mastic and patch with facing or tape.

C. See Section 233113 – Metal Ducts for protection of lined duct during construction.

END OF SECTION

SECTION 23 07 19 – PIPING AND EQUIPMENT INSULATION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Work Included in This Section: Materials, equipment, fabrication, installation, and tests in conformity with applicable codes and authorities having jurisdiction for the following:

1. Piping insulation.
2. **Insulate existing condensate piping above ceiling.**
3. Pipe insulation jacket.
4. Equipment insulation.

### 1.3 REFERENCE STANDARDS

A. ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM C177 – Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

C. ASTM C335 – Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

D. ASTM C585 – Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe.

E. ASTM C921 – Properties of Jacketing Materials for Thermal Insulation.

F. ASTM E84 – Surface Burning Characteristics of Building Materials.

G. ASTM E96 – Water Vapor Transmission of Materials.

H. NFPA 255 – Surface Burning Characteristics of Building Materials.

I. SMACNA – HVAC Duct Construction Standards - Metal and Flexible.

J. UL 723 – Surface Burning Characteristics of Building Materials.

K. ASTM E 814 – Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

1.4 QUALITY ASSURANCE

A. Source Quality Control.

1. Service: Use insulation specifically manufactured for service specified.
2. Labeling: Insulation labeled or stamped with brand name and number.

B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

a. One 10-foot section of NPS 2 straight pipe.
b. One each of a 90-degree threaded, welded, and flanged elbow.
c. One each of a threaded, welded, and flanged tee fitting.
d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
e. Four support hangers including hanger shield and insert.
f. One threaded strainer and one flanged strainer with removable portion of insulation.
g. One threaded reducer and one welded reducer.
h. One pressure temperature tap.
i. One mechanical coupling.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

1.5 SUBMITTALS

A. See Section 230010– Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Piping insulation | R | | | |
| Jackets | R | | | |
| Adhesives and coatings | R | | | |
| Mechanical fasteners | R | | | |
| Installer qualifications | R | | | |

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Insulation: Cellular glass.

1. Pittsburg-Corning
2. Or equal.

C. Insulation: fiberglass.

1. Owens-Corning Fiberglass Corporation.
2. Manville.
3. Certainteed Corporation.
4. Knauf.
5. Or equal.

D. Insulation: Elastomeric Closed Cell.

1. Armstrong World Industries, Inc.
2. Rubatex Corporation.
3. Or equal.

E. Weatherproof Aluminum Jacket.

1. Childers Products Company.
2. Insul-Coustic/Birma Corporation.
3. Or equal.

F. Pre-molded pipe fitting covers and Jacketing.

1. Manville: Zeston.
2. Childers Products Company.
3. Proto Corporation.
4. Insul-Coustic/Birma Corporation.

5. Or equal.

G. Adhesives.

1. Foster Div. Amchem Products Inc.
2. Childers Products Company.
3. Epolux Mfg. Corporation.
4. Insul-Coustic/Birma Corporation.
5. Armstrong 520 Adhesive.
6. Or equal.

H. Mechanical Fasteners.

1. AGM Industries, Inc.
2. Miracle Adhesives Corporation.
3. Grip-Nail.
4. Or equal.

## 2.2 GENERAL

A. Energy Codes: The current versions of ASHRAE 90.1 shall govern where requirements for thickness exceeds thickness specified.

B. All insulation materials, including jackets, facings, adhesives, coatings, and accessories are to be fire hazard rated and listed by Underwriters' Laboratories, Inc., using Standard UL 723 (ASTM E-84), (NFPA-255), (ASA A2.5-1963).

1. Flamespread: maximum 25.
2. Fuel contributed and smoke developed: maximum 50.
3. Flameproofing treatments subject to deterioration from moisture or humidity are not acceptable.

C. Insulation and accessories shall not provide any nutritional or bodily use to fungi, bacteria, insects, rats, mice, or other vermin, shall not react corrosively with equipment, piping, or ductwork, and shall be asbestos free: Duct lining shall meet ASTM C1136 and ASTM C665 for biological growth in insulation.

D. Provide a continuous vapor seal for any service piping that carries liquid below 60 degrees Fahrenheit.

## 2.3 PIPE INSULATION

A. Cellular Glass.

1. Insulation (without jacket) ASTM C 552, Type II, Class 1.
2. Insulation (with jacket) ASTM C552, Class 2.
3. Sectional.
4. 0.32 maximum K-factor at 75 degrees Fahrenheit mean temperature.
5. Pittsburg-Corning or equal.

B. Fiberglass.

1. Molded: one piece, with factory-applied, all purpose, vapor retarder jacket, maximum 0.26 K factor at 75 degrees Fahrenheit mean temperature: Owens-Corning ASJ/SSL-II Pipe Insulation or equal.

C. Flexible, closed cell elastomeric thermal insulation.

1. Insulation ASTM C534.
2. Service rating of 220 degrees Fahrenheit.
3. Density 6.0 pounds per cubic foot.
4. Closed cell foam: Vapor permeability ASTM E96 0.2 perm.
5. Max moisture absorption: 1.0 percent by volume, 10 percent by weight.
6. Molded pipe insulation.

    a. Maximum 0.27 K factor at 75 degrees Fahrenheit mean temperature
    b. Maximum water vapor transmission rating of 0.17 perm-inches,

7. Sheet insulation.

    a. Maximum 0.28 K factor at 75 degrees Fahrenheit mean temperature.
    b. Maximum water vapor transmission rating of 0.17 perm-inches.

8. Seal with Rubatex adhesive or equal: Armstrong Armaflex II or equal.

D. Underground pipe insulation: See Section 232113 – Hydronic Piping.

## 2.4 EQUIPMENT INSULATION

A. Flexible, closed cell elastomeric thermal insulation.

1. Insulation ASTM C534, Type II sheet material.
2. Service rating of 220 degrees Fahrenheit.
3. Density 6.0 pounds per cubic foot.
4. Closed cell foam: Vapor permeability ASTM E96 0.2 perm.
5. Max moisture absorption: 1.0 percent by volume, 10 percent by weight.
6. Sheet insulation.

    a. Maximum 0.28 K factor at 75 degrees Fahrenheit mean temperature.
    b. Maximum water vapor transmission rating of 0.17 perm-inches.

7. Seal with Rubatex adhesive or equal: Armstrong Armaflex II or equal.

## 2.5 JACKETS

A. Factory Applied Vapor Barrier All Service Jacket (ASJ).

1. ASTM C921, White kraft paper bonded to aluminum foil and reinforced with glass fiber yarn.
2. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
3. Secure with self-sealing longitudinal laps and butt strips.
4. Secure vapor barrier mastic.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.
6. Vapor Barrier Lap Adhesive: Compatible with insulation.

B. Aluminum Jacket: ASTM B209.

1. Use for weatherproof jacket.
2. Thickness: 0.016 inch sheet.
3. Finish: Embossed.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.

C. Preformed PVC.

1. Polyvinylchloride covers similar to Manville Zeston.
2. Colors:

a. Chilled Water: Blue.
b. Condenser Water: Light blue.
c. Heating Water: Red.
d. Domestic Cold Water: Green.
e. Domestic Hot Water: Orange.

D. Equipment insulation facings: Foil-scrim-kraft laminate of aluminum foil facing, glass scrim reinforcing, kraft paper backing.

E. Preformed Pipe Fitting Covers:

1. Aluminum.

a. Factory fabricated formed covers.
b. General Aluminum Supply Corporation GASCO or equal.

2. PVC.

a. Factory fabricated formed covers.
b. Manville Zeston or equal.

## 2.6 ADHESIVES AND COATINGS

A. Foster product names and figure numbers or equal.

1. Lagging adhesive: 30-36.
2. Fiberglass: Zeston Z-Glu.
3. Vapor barrier coating: Tite-fit 30-80, UP Label, comply with MIL-C-19565C, Type II; fire and water resistant.
4. Vaporseal adhesive: 85-60.

5. Cellular glass bedding and sealing compound adhesive: Foamseal 30-45.
6. Outdoor mastic: 30-90.
7. Asphalt mastic: C.I. Mastic 60-25.
8. For elastomeric insulation: 520 contact adhesive.

## 2.7 WIRE, BANDING AND FASTENING DEVICES

A. Wire: minimum 16 gauge copper clad annealed steel wire

B. Bands: 3/4 inches nominal width with wing seals, of minimum thickness as follows:

1. Aluminum: 0.007 inches. Except where exposed to weather, 0.020 inches.
2. Stainless steel: 0.010 inches.

C. Staples: outward clinching type of corrosion resistant steel.

## 2.8 MECHANICAL FASTENERS

A. Mild steel, copper plated.

B. AGM Industries Power Base insulation pins or equal.

C. Insulation washers:

1. Galvanized steel.
2. 1-1/2 inch diameter.
3. AGM Industries SLW-1 or equal.

## 2.9 PRE-INSULATED PIPE SUPPORT AND SHIELDS

A. Provide insulated pipe supports for all insulated pipe and tubing. Insulated pipe supports shall be Pipe Shields, Inc. or equal.

B. All insulated pipe supports shall be load rated. Load ratings shall be established by pipe support manufacturer based upon testing and analysis in conformance with the latest edition of the following codes: ASME B31.1, MSS SP-58, MSS SP-69 and MSS SP-89.

C. All insulated pipe supports shall have cellular glass insulation and galvanized steel jackets. Pipe supports for use on flat surfaces shall have integral load distribution plates coated with zinc primer minimum 3 mils thick.

D. See Section 230529 – Hangers and Supports.

E. Hangers and supports shall fit outside of all pipe insulation and insulation inserts. Provide pre-insulated pipe supports as specified and install per manufacturer's installation instructions. Shield lengths and gauges shall also be per manufacturer's recommendations.

F. Tape all butt joints where pipe insulation butts up against hanger shield.

1. On hot pipe, apply three inch wide vapor barrier tape or band over the butt joint.
2. On chilled water piping, apply a wet coat vapor barrier lap cement on all butt joints and seal the joints with a minimum of three inch wide vapor tape or band.

2.10 FIRE-STOPPING

A. At pipe penetrations through rated assemblies.

B. Commercial pipe sleeve assemblies that are UL listed and that have been approved by the fire marshal for this purpose.

C. Insulation shall be continuous through penetration.

2.11 ACCESSORIES

A. Insulation Protection Saddles: 12-inch long, 16 gauge steel.

B. Paint: Ultraviolet resistant latex paint with special adherence capabilities to the fitting covers, elastomeric, aluminum facing, Kraft paper, tapes and adhesives.

## PART 3 - EXECUTION

3.1 PIPE & EQUIPMENT INSULATION SCHEDULE

A. Type P-1.

1. Molded fiberglass.
2. All-service jacket (ASJ).
3. Vapor sealed.

B. Type P-1A.

1. Molded fiberglass.
2. All-service jacket (ASJ).
3. Vapor sealed.
4. PVC jacket.

C. Type P-1B.

1. Molded fiberglass.
2. All-service jacket (ASJ).
3. Vapor sealed.
4. Metal jacket.

D. Type P-2.

1. Flexible elastomeric insulation.

E. Type P-3.

1. Cellular glass insulation.
2. All service jacket (ASJ).
3. Vapor sealed.

F. Type P-3A.

1. Cellular glass insulation.
2. All service jacket (ASJ).
3. Vapor sealed.
4. PVC jacket.

G. Type P-3B.

1. Cellular glass insulation.
2. All service jacket (ASJ).
3. Vapor sealed.
4. Metal jacket.

H. Type E-1.

1. Flexible elastomeric insulation.

I. Application Schedule.

| Piping Systems | Location | Type | Pipe Size | Insulation Thickness | Freeze Protection |
|---|---|---|---|---|---|
| Condenser Water | Interior exposed | P-3A | 4” and Smaller | 1-1/2” | - |
| | | | 6” and Larger | 2" | - |
| | Exterior | P-3B | 4” and Smaller | 2” | Yes |
| | | | 6” and Larger | 3-1/2” | Yes |
| Floor Drain Bodies and related horizontal and vertical Sanitary Drain Lines above floor that receive cold condensate drain-age. | Interior | P-2 | 4” and smaller | 3/4" | - |
| Cold Condensate Drain Lines. **New and existing condensate lines to remain.** | Interior | P-2 | All Sizes | 3/4" | - |
| Refrigerant suction | All | P-2 | All Sizes | 3/4" | - |
| Condensate, and sanitary sewer waste/vent piping receiving condensate (horizontal piping and vertical piping, Underside of floor drain bodies receiving | Interior | P-2 | All Sizes | 3/4" | |

| Piping Systems | Location | Type | Pipe Size | Insulation Thickness | Freeze Protection |
|---|---|---|---|---|---|
| condensate) | | | | | |
| Domestic cold water | Interior concealed | P-1 | 1-1/2" and smaller | 1/2" | - |
| | | | 2" and larger | 3/4" | - |
| | Interior exposed | P-1A | 1-1/2" and smaller | 1/2" | - |
| | | | 2" and larger | 3/4" | - |
| | Exterior exposed | P-1B | All Sizes | 3/4" | Yes |
| Domestic hot water (includes recirculation piping) | Interior concealed | P-1 | 1-1/2" and smaller | 3/4" | - |
| | | | 2" and larger | 1" | - |
| | Interior exposed | P-1A | 1-1/2" and smaller | 3/4" | - |
| | | | 2" and larger | 1" | - |
| | Exterior exposed | P-1B | All Sizes | 1" | Yes |
| Roof drains (horizontal piping and vertical piping) | All | P-1 | All Sizes | 3/4" | - |
| | | P-2 | All Sizes | 1" | - |

K. Non-insulated piping and equipment.

1. Pneumatic tubing.
2. Control valves. (Note: this exclusion applies only to the valves themselves; all other hot water piping and accessories, including that between isolation valves and coils, shall be insulated.)

3.2 INSTALLATION

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

B. Coordinate with work of other trades.

C. Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.

D. Install insulation where it cannot become wet. If insulation becomes wet, remove, and dispose of properly and replace with new, dry insulation. Wetted insulation is not acceptable. Ensure insulation is dry before and during installation.

E. Insulate all piping, valves, fittings, flanges, and accessories.

F. On piping exposed to public view, locate insulation and cover seams in least visible locations.

G. Insulate fittings, joints, and valves with insulation of same material and thickness as adjoining pipe. Use pre-molded fiberglass fittings. For strainers, expansion joints, fittings and accessories requiring

servicing or inspection insulation shall be removable and replaceable without damage. Enclose within two-piece no. 15 gauge aluminum covers fastened with cadmium-plated bolts and nuts.

H. Insulate flanges with insulation sleeve of same material as pipe insulation to cover flange and overlap insulation on adjacent piping.

I. Continue insulation through walls, sleeves, pipe hangers and other pipe penetrations.

J. Finish insulation at supports, protrusions, and interruptions. No hangers or supports shall be embedded in insulation. Do not insulate expansion bellows.

K. Fiberglass insulation.

1. Provide insulation with factory applied vapor barrier jackets.
2. Butt edges neatly. ASJ with 3 inch minimum butt strips.
3. Longitudinal overlaps: Minimum 2 inch self-sealing, double adhesive.
4. Apply additional jacket as specified.
5. For insulation with factory-applied jackets, secure laps with aluminum or stainless-steel bands at 18 inches o.c.
6. For piping conveying fluids below ambient temperature finish with vapor barrier adhesive.

L. Cellular glass insulation.

1. Provide insulation with factory applied vapor barrier jackets.
2. Butt edges neatly. Seal longitudinal and transverse joints with adhesive to maintain minimum vapor permeance. Adhesive shall be selected and applied in accordance with insulation manufacturer’s recommendations.
3. Secure insulation sections with bands without deforming insulation materials.
4. Build up coating of insulating and finishing cement.
5. For insulation with factory-applied jackets, secure laps with aluminum or stainless-steel bands at 18 inches o.c.
6. For piping conveying fluids below ambient temperature finish with vapor barrier adhesive.
7. Apply additional jacket as specified. If no additional jacket specified apply skim coat of finishing cement to smooth out surface of fitting insulation.

M. Elastomeric Tubing.

1. Butt edges neatly. Seal longitudinal and transverse joints with adhesive to maintain minimum vapor permeance. Adhesive shall be selected and applied in accordance with insulation manufacturer’s recommendations.
2. Apply additional jacket as specified.

N. For all pipe systems exposed in the mechanical equipment rooms, finish with an all service, PVC jacket.

O. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

P. For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

Q. Perform work at ambient and equipment temperatures as recommended by adhesive manufacturer.

R. Protection: Protect against dirt, water, chemical, or mechanical damage before, during, and after installation. Repair or replace damaged insulation at no additional cost.

S. Paint all insulation exposed to ultraviolet light (sunlight).

T. All vapor barriers shall be continuous. Tears, holes, staples, etc. shall be coated with vapor barrier mastic and patch with facing or tape.

U. Joints between insulation and access shall be sealed with vapor barrier mastic.

## 3.3 PIPE INSULATION APPLICATION

A. General.

1. Before applying insulation.

    a. Test piping for tightness and obtain approval.
    b. Dry pipe thoroughly.
    c. Clean surfaces to be insulated of dust, grease, and foreign matter.

2. Butt edges neatly.
3. Fill voids with insulating cement.
4. Longitudinal overlaps.

    a. 2 inches minimum.
    b. For exposed work: toward ceiling or wall.
    c. For weatherproof aluminum jackets: on side to shed water.

5. Circumferential overlaps on weatherproof aluminum jackets: 2 inches minimum.
6. Continuous insulation passing through sleeves or other openings.
7. Oversize insulation to accommodate heat tracing on piping.

B. Valves, fittings, flanges, and accessory insulation.

1. Unless otherwise noted, insulate:

a. Valves including bonnets.
b. Flanges.
c. Fittings.
d. Strainers.
e. Expansion joints.
f. Specialties.

2. Insulation for strainers, expansion joints, fittings and accessories requiring servicing or inspection.

a. Insulation removable and replaceable without damage.
b. Enclosed within two-piece No. 18 gauge aluminum covers fastened with cadmium plated bolts and nuts.

3. Insulation of same thickness as adjacent piping insulation.
4. For piping systems insulated with fiberglass.

a. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
b. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

5. For piping systems insulated with cellular glass.

a. Apply pre-molded insulation sections of the same material as straight segments of pipe when available. Secure according to manufacturer’s written instructions.
b. When pre-molded insulation elbows and fittings are not available, apply mitered sections of pipe insulation (blanket insulation is not acceptable) to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
c. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

6. For piping systems insulated with elastomeric thermal insulation.

a. Apply mitered sections of pipe insulation.
b. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

7. Flanges.

a. Apply preformed pipe insulation to outer diameter of pipe flange.

b. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with the same insulation material as adjacent piping insulation.
d. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

8. Finish for outdoor locations only: weatherproof aluminum jacket compatible with weatherproof jacket on adjoining pipe insulation.

C. At pipe hangers.

1. Insulation protection shields specified in Section 230529 – Hangers and Supports.
2. Butt insulation to shields.
3. Cold piping: Wet coat of vapor barrier lap cement on all butt joints.

D. Jackets and facings.

1. Vapor-sealed types: continuous; staples not permitted.
2. Adhere longitudinal laps: Adhere 3 inches wide joint strip, of same material as facing, at center of each butt joint.
3. Adhesives.

a. Vapor-sealed insulation: vapor-seal adhesive.
b. Heating service insulation: vapor-seal adhesive.
c. Weatherproof aluminum jacket: sealing compound.
d. PVC jacket: welding compound.
e. Underground asphalt felt jacket: asphalt mastic

E. Wiring, banding, and fastening devices: Secure insulation to piping and equipment in accordance with following minimum requirements.

1. Piping insulation section 3 foot long.

a. Concealed vapor-sealed insulation banded at ends and center.
b. Other concealed insulation banded at ends and center.

2. Pipe fitting insulation.

a. Loops of wire to secure mitered segments of insulation.
b. Wire spiraled on from end to end on blanket insulation

3. Outdoor piping weatherproof aluminum jackets banded at circumferential joints and center of each section: Lap joint at bottom.

3.4 EQUIPMENT INSULATION

A. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Secure insulation to equipment with bands, welded-on anchors, ties, or adhesive. Where access to equipment is required for testing or maintenance the insulation shall be installed so that it is removable and so that the vapor barrier can be remade after access.

B. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

C. For cold equipment or equipment containing fluids below ambient temperature.

1. Insulate entire system.
2. Provide vapor barrier jackets, factory applied, or field applied.
3. Finish with glass cloth and vapor barrier adhesive.
4. Cover with aluminum jacket where specified.

D. For equipment containing fluids above ambient temperature.

1. Insulate entire system.
2. Provide standard jackets, with or without vapor barrier, factory applied, or field applied.
3. Finish with glass cloth and adhesive.
4. Cover with aluminum jacket where specified.
5. For hot equipment containing fluids 140 degrees Fahrenheit or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
6. For hot equipment containing fluids over 140 degrees Fahrenheit, insulate flanges and unions with removable sections and jackets.

E. Finish insulation at supports, protrusions, and interruptions.

F. For equipment in mechanical equipment rooms or in finished spaces, finish with aluminum jacket.

G. Do not insulate over nameplate or ASME stamps; bevel and seal insulation around such.

H. General.

1. Apply insulation with edges tightly butted.

a. Joints staggered and secured in place by steel bands.
b. Where necessary weld on suitable anchors.

2. Seal with 520 adhesive.

I. Special considerations.

1. Chiller heads: removable and replaceable covers to allow tube removal.
2. Strainers and suction diffusers: removable and replaceable covers to allow strainer removal.

3. Pumps: removable and replaceable covers to allow impeller replacement.
4. Provide sufficient clearance around openings for normal operation of equipment.

## 3.5 PENETRATION THROUGH RATED WALLS

A. Refer to drawings for penetrations of rated assemblies.

B. Install per manufacturer's installation and listing requirements.

## 3.6 FIELD QUALITY CONTROL

A. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

B. All vapor barriers shall be continuous; tears, holes, staples, etc. shall be coated with vapor barrier mastic and patch with facing or tape.

END OF SECTION

SECTION 23 09 00- ENERGY MANAGEMENT AND CONTROL SYSTEM - GENERAL

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 ALLOWANCE FOR PURCHASE OF THE ENERGY MANAGEMENT AND CONTROL SYSTEM

A. An allowance for inclusion in the Contract Sum has been specified in Division One Supplement, Section 019000, "Part 2 – Allowance Supplement" for purchase of the EMCS.

B. A Request for Proposals (RFP) will be issued by the successful General Contractor to receive bids for the Energy Management and Control System (EMCS) contractor selection. The RFP shall be distributed to the approved EMCS contractors referenced herein and sealed proposals received by the Architect. The Architect will make an EMCS contractor recommendation to the Owner based upon proposals received.

### 1.3 SUMMARY

A. Contractor shall furnish and install a direct digital control and Energy Management and Control System-General (EMCS).

B. The systems to be controlled under work of this Section include but are not limited to the following:

1. HVAC Systems

### 1.4 RELATED WORK AND REQUIREMENTS

A. Other EMCS Sections:

1. Section 230913 EMCS Basic Materials and Devices
2. Section 230916 EMCS Operator Interfaces
3. Section 230919 EMCS Field Panels
4. Section 230923 EMCS Communication Devices
5. Section 230926 EMCS Software and Programming
6. Section 230933 EMCS Commissioning

B. Coordination with other Divisions. The table in specification 230010 paragraph 1.2-B shall be used to determine scope of work between Division 21, 22 and 23, and other Divisions including Divisions 21, 22. 23, and 26. All work not specified to be a part of the EMCS scope of work shall be provided by General Contractor and associated subcontractors for each building and the infrastructure.

C. Testing and Commissioning.

1. Section 230593 Testing, Adjusting and Balancing
2. Section 230933 EMCS Commissioning

D. Communications.

1. Connection to Owner's IT WAN/LAN and terminations to wall jack shall be by Division 23C Contractor. Coordinate connection location of IT WAN/LAN and terminations with Division 26. This connection shall also provide access to Internet through Owner's firewall to Internet Services Provider procured by Owner.
2. Network IT WAN/LAN drop at required EMCS location(s) specified under Division 26. It shall be the responsibility of the Division 23C contractor to communicate required IT WAN/LAN drop location(s) with Division 26.

E. Integration with Existing System

1. Include all services required to integrate this building into existing EMCS for a fully operational system.
2. Procedure.

a. Provide all controls work as indicated on drawings.
b. Develop all building level control system databases and control programming using existing standards and standard programming.
c. Install building databases and control programming on a temporary portable operator's terminal provided by the Contractor. The POT shall be used for start-up, testing, and commissioning. The POT shall remain the property of the Contractor after final completion of the project.
d. Once the building EMCS has been fully commissioned and accepted by the Owner, merge database and programming with those existing on the existing Operator Workstation and/or servers. Confirm that the merge was successful by sample testing points and sequences and approve final installation in writing.
e. Integrate graphic screens into the existing EMCS graphics including adding appropriate hyperlinks so that the system operates as one integrated system.
f. Provide high level password for Owner operator access to the system only at this point; Owner will not have access to the system prior to system acceptance and integrations.

## 1.5 REFERENCE STANDARDS

A. Nothing in Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, and regulations. When Contract Documents differ from requirements of applicable laws, ordinances, rules, and regulations, EMCS contractor shall comply with documents establishing the more stringent requirement.

B. The latest published or effective editions, including approved addenda or amendments, of the following codes and standard shall apply to the EMCS design and installation as applicable.

C. State and Local Codes:

1. Local City and County Codes.

D. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

1. ASHRAE 135: BACnet - A Data Communication Protocol for Building Automation and Control Networks.

E. Electronics Industries Alliance.

1. EIA-232: Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
2. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes.
3. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
4. EIA-472: General and Sectional Specifications for Fiber Optic Cable.
5. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications.
6. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications.
7. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications.

F. Underwriters Laboratories.

1. UL 916: Energy Management Systems.

G. NEMA Compliance.

1. NEMA 250: Enclosure for Electrical Equipment.
2. NEMA ICS 1: General Standards for Industrial Controls.

H. NFPA Compliance.

1. NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

I. Institute of Electrical and Electronics Engineers (IEEE).

1. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems.
2. IEEE 802.3: CSMA/CD (Ethernet – Based) LAN.
3. IEEE 802.4: Token Bus Working Group (ARCNET – Based) LAN.

1.6 DEFINITIONS

A. Acronyms

| | |
|---|---|
| AAC | Advanced Application Controller |
| AH | Air Handler |
| AHU | Air Handling Unit |
| AI | Analog Input |
| ANSI | American National Standards Institute |
| AO | Analog Output |
| APDU | Application Protocol Data Unit |
| ASC | Application Specific Controllers |
| ASCII | American Standard Code for Information Interchange |
| ASHRAE | American Society of Heating, Refrigeration and Air Conditioning Engineers. |
| ASME | American Society of Mechanical Engineers. |
| ASTM | American Society for Testing and Materials. |
| A-to-D | Analog-to-Digital |
| BACnet | Data Communications Protocol for Building Automation and Control Systems |
| BC | Building Controller |
| BIBB | BACnet Interoperability Building Blocks |
| BMA | BACnet Manufacturers Association \ |
| CAD | Computer Aided Drafting |
| CHW | Chilled Water |
| CHWR | Chilled Water Return |
| CHWS | Chilled Water Supply |
| COV | Change of Value |
| CSS | Control Systems Server |
| CU | Controller or Control Unit |
| CV | Constant Volume |
| CW | Condenser Water |
| CWR | Condenser Water Return |
| CWS | Condenser Water Supply |
| DCS | Digital Control Stations |
| DBMS | Database Management System |
| DDC | Direct Digital Control |
| DHW | Domestic Hot Water |
| DI | Digital Input |
| DO | Digital Output |
| D-to-A | Digital-to-Analog |
| EMCS | Energy Management and Control System |
| EMT | Electrical Metallic Tubing |
| EP | Electro-Pneumatic |
| ETL | Edison Testing Laboratories. |
| GUI | Graphical User Interface |
| HOA | Hand-Off-Automatic |
| HVAC | Heating, Ventilating and Air- |

| | |
|---|---|
| | Conditioning' |
| HTTP | Hyper-Text Transfer Protocol |
| I/O | Input/output |
| IEEE | Institute of Electrical and Electronics Engineers |
| ISO | International Organization for Standardization |
| LAN | Local Area Network |
| LANID | LAN Interface Device |
| LCP | Lighting Control Panel |
| MAC | Medium Access Control |
| MHz | Megahertz |
| MS/TP | Master-Slave/Token-Passing |
| NEMA | National Electrical Manufacturers Association |
| NFPA | National Fire Protection Association. |
| NIST | National Institute of Standards and Technology |
| ODBC | Open Database Connectivity |
| OI | Operator Interface |
| OWS | Operator Workstation |
| P | Proportional |
| PC | Personal Computer |
| PI | Proportional-Integral |
| PICS | Protocol Implementation Conformance Statement |
| PID | Proportional-Integral-Derivative |
| POT | Portable Operators Terminal |
| PTP | Point-to-Point |
| RAM | Random Access Memory |
| SOO | Sequence of Operation |
| SQL | Standardized Query Language |
| SSL | Secure Socket Layers |
| TAB | Test, Adjust, and Balance |
| TDR | Time Delay Relay |
| THS | Trend Historian Server |
| UL | Underwriters' Laboratories, Inc. |
| XML | Extensible Markup Language |

B. Terms

| Term | Definition |
|---|---|
| Accessible | Locations that can be reached with no more than a ladder to assist access and without having to remove permanent partitions or materials. Examples include inside mechanical rooms, mechanical equipment enclosures, instrument panels, and above suspended ceilings with removable tiles. |
| Advanced Application Controller | A device with limited resources relative to the Building Controller. It may support a level of programming and may also be intended for application specific applications. |

| | |
|---|---|
| Application Protocol Data Unit | A unit of data specified in an application protocol and consisting of application protocol control information and possible application user data (ISO 9545). |
| Application Specific Controller | A device with limited resources relative to the Advanced Application Controller. It may support a level of programming and may also be intended for application-specific applications. . |
| BACnet Interoperability Building Blocks | A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device in a specification. |
| BACnet/BACnet Standard | BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved addenda. |
| Building Controller | A fully programmable device capable of carrying out a number of tasks including control and monitoring via direct digital control of specific systems, acting as a communications router between the LAN backbone and sub-LANs, and data storage for trend information, time schedules, and alarm data. |
| Change of Value | An event that occurs when a digital point changes value or an analog value changes by a predefined amount |
| Client | A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device. |
| Concealed | Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. |
| Continuous Monitoring | A sampling and recording of a variable based on time or change of state (e.g. trending an analog value, monitoring a binary change of state). |
| Contract Documents | Specifications, drawings, and other materials provided with request for bids. |
| Contractor, EMCS Contractor, or Division 23C Contractor | The Contractor retained by Owner to execute the work defined in Division 23C and associated design documents |
| Control Systems Server | A computer (or computers) that maintains the systems configuration and programming database. |
| Controller or Control Unit | Intelligent stand-alone control panel. Controller is a generic reference and shall include BCs, AACs, and ASCs as appropriate. |
| Digital Control Stations | One or more EMCS control panels |
| Direct Digital Control | Microprocessor-based control including Analog/Digital conversion and program logic |
| Energy Management and Control System | The entire integrated management and control system |
| Equal | Approximately equal in material types, weight, size, design, quality, and efficiency of specified product. |

| | |
|---|---|
| Exposed | Not installed underground or concealed. |
| Extensible Markup Language | A specification developed by the World Wide Web Consortium. XML is a pared-down version of SGML, designed especially for Web documents. It allows designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations. |
| Functional Profile | A collection of variables required to define the key parameters for a standard application. As this applies to the HVAC industry, this would include applications like VAV terminal, fan coil units, and the like. |
| Gateway | Bi-directional protocol translator connecting control systems that use different communication protocols |
| Hand-Held Device | Manufacturer's microprocessor-based device for direct connection to a Controller. |
| Inaccessible | Locations that do not meet the definition of accessible. Examples include inside furred walls, pipe chases and shafts, or above ceilings without removable tiles. |
| Indicated, shown or noted | As indicated, shown, or noted on drawings or specifications. |
| Install | To erect, mount and connect complete with related accessories. |
| Instrumentation | Gauges, thermometers, and other devices mounted in ductwork or piping that are not a part of the automatic temperature control system |
| IT LAN | Reference to the facility's Information Technology network, used for normal business-related e-mail and Internet communication. |
| LAN Interface Device | Device or function used to facilitate communication and sharing of data throughout the EMCS |
| Local Area Network | General term for a network segment within the architecture. |
| Supervisory LAN | Ethernet-based LAN connecting Primary Controller LANs with each other and OWSs, CSS, and THS. See System Architecture below. |
| Master-Slave/Token Passing | Data link protocol as defined by the BACnet standard. |
| Motor Controllers | Manual or magnetic starters (with or without switches), individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors. |
| Open Database Connectivity | An open standard application-programming interface for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system is handling the data. |
| Operator Interface | A device used by the operator to manage the EMCS including OWSs, POTs, and HHDs. |
| Operator Workstation | The user's interface with the EMCS system. As the EMCS network devices are stand-alone, the OWS is not required for communications to oc- |

| | |
|---|---|
| | cur. |
| Piping | Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items. |
| Points | All physical I/O points, virtual points, and all application program parameters. |
| Point-to-Point | Serial communication as defined in the BACnet standard. |
| Portable Operators Terminal | Laptop PC used both for direct connection to a controller and for remote dial up connection. |
| Primary Controlling LAN | High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture below. |
| Protocol Implementation Conformance Statement | A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device (ASHRAE/ANSI 135). |
| Provide | To supply, install and connect-up complete and ready safe and regular operation of particular work referred to unless specifically noted. |
| Reviewed, approved, or directed | As reviewed, approved, or directed by the Owner. |
| Router | A device that connects two or more networks at the network layer. |
| Secondary Controlling LAN | LAN connecting AACs and ASCs. Generally lower speed and less reliable than the Primary Controlling LAN. Refer to System Architecture below. |
| Server | A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device. |
| Smart Device | A control I/O device such as a sensor or actuator that can directly communicate with the controller network to which it is connected. This differs from an ASC in that it typically deals only with one variable. |
| Standardized Query Language | A standardized means for requesting information from a database. |
| Supply | To purchase, procure, acquire, and deliver complete with related accessories. |
| Trend Historian Server | A computer (or computers) that maintains the database of recorded trend logs. |
| Owner | Owner, University, Institution and/or its designated representatives. |
| Wiring | Raceway, fittings, wire, boxes, and related items. |
| Work | Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation. |

1.7 QUALITY ASSURANCE

A. Materials and Equipment

1. Manufacturer's Qualifications: See PART 2 for approved manufacturer.
2. Product Line Demonstrated History: The direct digital control equipment product line being proposed for the project must have an installed history of demonstrated satisfactory operation for a length of one year since date of final completion in at least 10 installations of comparative size and complexity.
3. All products used in this project installation shall be new, currently under manufacture, and shall have been available from the manufacturer for a minimum of 6 months prior to date of proposal and previously installed and proven effective in installations of similar nature, not including test sites. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner in writing. Spare parts shall be available for at least five years after completion of this contract.
4. All BACnet devices must either be certified as complaint with BACnet through the BACnet Manufacturers Association or the vendor must supply proof of having submitted the device for testing by BMA.
5. The EMCS and components shall be listed by Underwriters Laboratories UL 916 as an Energy Management System.

B. Installer

1. EMCS Contractor's Project Manager Qualifications: Individual shall specialize in and be experienced with direct digital control system installation for not less than 3 years. Project Manager shall have experience with the installation of the proposed direct digital control equipment product line for not less than 2 projects of similar size and complexity. Project Manager must have proof of having successfully completed the most advanced training offered by the manufacturer of the proposed product line.
2. EMCS Contractor's Programmer Qualifications: Individual(s) shall specialize in and be experienced with direct digital control system programming for not less than 3 years and with the proposed direct digital control equipment product line for not less than 1.5 years. Programmers must show proof of having successfully completed the most advanced programming training offered by the vendor of the programming application on the proposed product line.
3. EMCS Contractor's Service Qualifications: The installer must be experienced in control system operation, maintenance, and service. EMS Contractor must document a minimum 5-year history of servicing installations of similar size and complexity. Installer must also document at least a 1-year history of servicing the proposed product line.
4. Installer’s Response Time and Proximity.

    a. Installer must maintain a fully capable service facility within Mississippi. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.
    b. Installer must demonstrate the ability to meet the emergency response times listed in herein.

5. Electrical installation shall be by manufacturer-trained electricians.

    a. Exception: Roughing in wiring/conduit and mounting panels may be subcontracted to any licensed electrician.

## 1.8 SUBMITTALS

A. No work may begin on any segment of this project until the related submittals have been reviewed for conformity with the design intent and the Contractor has responded to all comments to the satisfaction of the Architect.

B. Submit drawings, product data, samples and certificates of compliance required as hereinafter specified. See also Division 1 Shop Drawings, Product Data and Samples. Conditions in this Section take precedence over conditions in above referenced Section.

C. Submittal Schedule: Submittal schedule shall be as follows unless otherwise directed by the Owner:

1. Allow 10 working days for approval unless Architect agrees to accelerated schedule.
2. Submittal Package 1 (Hardware and Shop Drawings) shall be submitted in accordance with schedule established by the Owner in bid documents.
3. Submittal Package 2 (Programming and Graphics) and shall be submitted no less than 30 days before software is to be installed in field devices.
4. Submittal Package 3 (Functional Testing) shall be submitted no less than 30 days prior to conducting tests.
5. Submittal Package 4 (Training Materials) shall be submitted no less than 14 days prior to conducting first training class.
6. Submittal Package 5 (Post-Construction Trend Logs) shall be submitted after demonstration tests are accepted and systems are in full automatic operation. The list of points to be trended shall be submitted for approval 14 days prior to the start of the trend collection period.
7. Submittal Package 6 (End-of-Warranty Trend Logs) shall be submitted 30 days prior to the end of the warranty period.

D. Submission and Resubmission Procedure:

1. Each submittal shall have a unique serial number that includes the associated specification section followed by a number for each sub-part of the submitted for that specification section, such as SUBMITTAL 23 xx xx-01.
2. Each resubmittal shall have the original unique serial number plus unique revision number such as SUBMITTAL 23 xx xx-01 REVISION 1.
3. Submit one copy of submittal in electronic format specified under each submittal package below. Submissions made in the wrong format will be returned without action.

4. Submit two (2) and only two hard copies of submittals to Architect for review. Any additional copies will be returned without review.
5. Architect will return one copy with comments and corrections noted where required.
6. Make corrections:

    a. Revise initial drawings or data.
    b. Indicate any changes that have been made other than those requested.
    c. Clearly identify resubmittal by original submittal number and revision number.

7. Resubmit two (2) and only two copies of revised submittals to Architect for review until no exceptions are taken.
8. Once submittals are accepted and stamped with no exceptions taken, Contactor shall make photocopies for coordination with other trades, as required by the General Contractor. Photocopies will serve as submittal for record and coordination.

E. Submittals Packages

1. Submittal Package 1 (Hardware and Shop Drawings).

    a. Provide Installer and Key personnel qualifications as specified.
    b. Hardware

        1) Organize by specification section and device tags as tagged in these specifications.
        2) Do not submit products that are not used even if included in specifications.
        3) Include a summary table of contents listing for every submitted device:

            a) Tab of submittal file/binder where submittal is located.
            b) Device tag as tagged in these specifications (such as TS-1A, FM-1).
            c) Specification section number (down to the lowest applicable heading number).
            d) Whether device is per specifications and a listed product or a substitution.
            e) Manufacturer.
            f) Model Number.
            g) Device accuracy (where applicable).
            h) Accuracy as installed including wiring and A/D conversion effects (where applicable).

        4) Submittal shall include manufacturer’s description and technical data, such as performance data, product specification sheets, and installation instructions for all control devices and software.
        5) When manufacturer's cut-sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or

clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements.

6) A BACnet_ Protocol Implementation Conformance Statement (PICS) for each type of controller and operator interface shall be included submittals.
7) Format: Electronic word-searchable format.

c. Shop Drawings

1) Format

a) Sheets shall be consecutively numbered.
b) Each sheet shall have a title indicating the type of information included and the mechanical/electrical system controlled.
c) Table of Contents listing sheet titles and sheet numbers.
d) Legend and list of abbreviations.
e) Schematics: (AutoCAD compatible format, 17 inch x 11 inch.)
f) Floor plans: None required.

2) System architecture one-line diagram indicating schematic location of all control units, workstations, LAN interface devices, gateways, etc. Indicate address and type for each control unit. Indicate media, protocol, baud rate, and type of each LAN.
3) Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. The schematics provided with bid package shall be the basis on the EMCS Contractor's schematics with respect to control points, but EMCS Contractor may use alternative graphics format.
4) All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.
5) With each schematic, provide a point summary table listing building number and abbreviation, system type, equipment type, full point name, point description, Ethernet backbone network number, network number, device ID, object ID (object type, instance number). See Section 230926 - Part 3 for additional requirements.
6) Label each control device with setting or adjustable range of control.
7) Label each input and output with the appropriate range.
8) Device table (Bill of Materials). With each schematic, provide a table of all materials and equipment including:

a) Device tag as indicated in the schematic and actual field labeling (use tag as indicated in these specifications where applicable and practical.)

b) Device tag as indicated in these specifications where applicable and if it differs from schematic device tag.
c) Description.
d) Proposed manufacturer and model number.
e) Range.

9) With each schematic or on separate valve sheet, provide valve and actuator information including size, $C_v$, design flow, target pressure drop, actual design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of spring return valves and dampers.
10) Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
11) Details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations.

d. Do not include sequence of controls on shop drawings or equipment submittals; they are included in Submittal Package 2.
e. Submit along with shop drawings but under separate cover memory allocation projections and calculated and guaranteed response times of the most heavily loaded LAN in the system.

2. Submittal Package 2 (Programming and Graphics).

a. A detailed description of point naming convention conforming to Section 230926 to be used for all software and hardware points, integrated with existing database convention.
b. A list of all hardware and software points identifying their text names, device addresses and descriptions.
c. Control Logic Documentation:

1) Submit control logic program listings (graphical programming) consistent with specified English-language Sequences of Operation for all control units.
2) Control logic shall be annotated to describe how it accomplishes the sequence of operation. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation.
3) Include specified English-language Sequences of Operation of each control sequence updated to reflect any suggested changes made by the Contractor to clarify or improve the sequences. Changes shall be clearly marked. SOO shall be fully consistent with the graphical

programming. (An electronic version of the sequences of controls on drawings will be provided to the Contractor upon request.)

4) Include control settings, setpoints, throttling ranges, reset schedules, adjustable parameters, and limits.

5) Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation. This set will count toward the required number of Operation and Maintenance materials specified below.

d. Graphic screens of all required graphics, provided in final colors, one 11" x 8.5" page per screen.

e. Format:

1) Points list: Word-searchable format.

2) Programming: Native electronic file if interpreter is available, otherwise provide pdf files of screen shots.

3) Graphics: Graphical electronic format (pdf, png, etc.).

3. Submittal Package 3 (Functional Testing).

a. Provide pre-functional test forms as required by Section 230933.

b. Provide functional test forms as required by Section 230933.

c. Format: Word-searchable format.

4. Submittal Package 4 (Training Materials).

a. Provide training materials as required by Section 230933.

b. Format: Word-searchable format.

5. Submittal Package 5 and 6 (Trend Logs).

a. Provide a list of points being trended along with trend interval or change-of-value per drawings.

b. Provide trend logs as required on drawings.

c. Format: See Section 230926.

## 1.9 COMPLETION REQUIREMENTS

A. Procedure.

1. Until the documents required in this section are submitted and approved, the system will not be considered "accepted" and final payment to EMCS Contractor will not be made.
2. Before requesting acceptance of work, submit one set of completion documents for review and approval of Owner.
3. After review, furnish quantity of sets indicated below to Owner.

B. Completion Documents.

1. Operation and Maintenance (O & M) Manuals. Provide in both paper and electronic format per paragraph 1.8C.

a. Include all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual; in accordance with requirements of Division 1.
b. As-built versions of the submittal product data. Submittal data shall be located in tabs along with associated maintenance information.
c. Engineering, Installation, and Maintenance Manual(s) that explain how to design and install new points, panels, and other hardware; preventive maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
d. Complete original issue documentation, installation, and maintenance information for all third-party hardware and software provided, including computer equipment and sensors.
e. A list of recommended spare parts with part numbers and suppliers.
f. Operators Manual with procedures for operating the control systems, including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
g. Programming Manuals with a description of the programming language, control block descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the programming editor.
h. Recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.
i. A listing and documentation of all custom software for the project created using the programming language, including the set points, tuning parameters, and point and object database.
j. English language control sequences updated to reflect final programming installed in the EMCS at the time of system acceptance.

2. Complete original issue diskettes/CDs for all software provided, including operating systems, programming language, operator workstation software, and graphics software.
3. Project Record Drawings.

    a. “As-built” versions of the submittal drawings in reproducible paper and electronic format per paragraph 1.8C.
    b. Provide as-built network architecture drawings showing all BACnet nodes including a description field with specific controller/device identification, description, and location information.
    c. Record floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring. Indicate device instance, address and drawing reference number.

4. Commissioning Reports. Completed versions of all Pre-functional, Functional, and Demonstration Commissioning Test reports, calibration logs, etc., per Section 230933.

5. Copy of inspection certificates provided by the local code authorities.
6. Written guarantee and warranty documents for all equipment and systems, including the start and end date for each.
7. Training materials as required by Section 230933.
8. Contact information. Names, addresses, and 24-hour telephone numbers of contractors installing equipment, and the control systems and service representatives of each.

C. Format of Completion Documents.

1. Provide the type and quantity of media listed in table below.
2. Documents such as manuals and control sequences shall be in word-searchable electronic format such as MS Word, Adobe Acrobat (pdf), and HTML and broken into separate files for each type of equipment. Record drawings shall be in original format per paragraph 1.06F.
3. Optical media shall be readable on Operator Workstations.

| | Document | Paper (binder or bound) | Electronic | |
|---|---|---|---|---|
| | | | Read only optical disk | Loaded onto OWSs and POTs |
| 1. | O&M Manual | 5 | 1 | 1 |
| 2. | Original issue software | - | 1 per workstation | 1 |
| 3. | Project Record Drawings | 5 | 1 | 1 |
| 4. | Control sequences | 1 | 1 | 1 |
| 5. | Commissioning Reports | 5 | - | - |
| 6. | Inspection Certificates | 1 | - | - |
| 7. | Warranty documents | 1 | - | - |
| 8. | Training materials | 1 per trainee | - | - |
| 9. | Contact information | 1 | - | 1 |

D. Permanent On-site Documentation.

1. In panels, provide point list of all points in panel in sufficiently permanent manner that list cannot be easily removed (and lost).
2. Mount half size drawings of primary system schematics and network architecture in glass covered frame. The number of drawings will depend on the complexity of the system; compressed or abridged versions of shop drawings are acceptable provided all control points are shown. Mount the drawings in space available in mechanical rooms. Drawings may be mounted in different locations, e.g. air handler schematic may be in fan room, chiller schematic in chiller room, etc.

## 1.10 SYSTEM ARCHITECTURE

A. General.

1. The system provided shall incorporate hardware resources sufficient to meet the functional requirements of these Specifications. The Contractor shall include all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications.
2. The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and an operator workstation capable of expansion as specified herein.
3. System software shall be based on a server/thin-client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the Owner's local area network, and remotely over the Internet (through the Owner's LAN).
4. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to edit programming.
5. Performance Monitoring. The EMCS will provide the specified performance monitoring functionality, including required monitoring points and performance metrics, improved through system accuracy, data acquisition and data management capabilities, and required graphical and data displays.
6. Event Response. The EMCS will provide the specified operational changes based on event response from the energy service provider.
7. All control products provided for this project shall comprise an interoperable fully-native BACnet system, including all communication media, connectors, repeaters, hubs, and routers necessary for the network. All control products provided for this project shall conform to ANSI/ASHRAE Standard 135.

B. EMCS network architecture.

1. Supervisory LAN: The LAN shall be an Ethernet-based, 100/1000 Mbps network connecting the control system servers and OWSs to routers in each building. Contractor shall utilize the Owner's Enterprise IT LAN/WAN for this purpose. This network shall be BACnet/IP as defined in Addendum A (Annex J) of the BACnet standard and shall share a common network number for the Ethernet backbone, as defined in BACnet.
2. Primary Controller LAN (Primary LAN): High-speed, peer-to-peer communicating LAN used to connect AACs, ASCs and BCs and communicate exclusively control information. Acceptable technologies include:

   a. Ethernet (IEEE 802.3).

3. Secondary Controller LAN (Secondary LAN or sub LAN): Network used to connect AACs and ASCs. These can be Master Slave/ Token Passing or polling, in addition to those allowed for Primary Controller LANs. Network speed vs. the number of controllers on the LAN shall be dictated by the response time and trending requirements.

C. Operator Interfaces and Servers.

1. Control Systems Server (CSS). This shall be a server upon which the systems configuration and programming databases are maintained and serves as web server for operator interface. It shall hold the backup files of the information downloaded into the individual controllers and as such support uploading and downloading that information directly to/from the controllers. It shall also act as a control information server to non-control system-based programs. It shall allow secure multiple access to the control information.
2. The Operator Workstations and Portable Operator Terminals shall provide for overall system supervision, graphical user interface, management report generation, and alarm annunciation.
3. Remote monitoring and control shall be through use of a web browser through the Owner's IT LAN and via the internet through the Owner's IT LAN.
4. The operator interface and server already exist. Modify existing hardware and software as needed for the project.

D. Controllers. The BCs, AACs, and ASCs shall monitor, control, and provide the field interface for all points specified. Each BC, AAC, or ASC shall be capable of performing all specified energy management functions, and all DDC functions, independent of other BCs, AACs, or ASCs and operator interface devices.

E. Gateways.

1. Gateways shall be provided only as required for connection to the following:

a. Water source heat pumps.

2. Where gateways are used, critical points shall be hard-wired from the DDC system to the controlled device, rather than using the gateway, to avoid problems with gateway failures, currently a common problem. Critical points are those that are essential for proper operation and are listed in points list as separate points. Where listed, these points shall be hard-wired even when available through gateway.

## 1.11 SYSTEM PERFORMANCE

A. The communication speed between the controllers, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. This includes when system is collecting trend data for commissioning and for long term monitoring. (See Section 230933.) In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein, assuming no other simultaneous operator activity. Contractor shall reconfigure LAN as necessary to accomplish these performance requirements. This does not apply to gateways and their interaction with non-EMCS-vendor equipment.

1. Object Command. The maximum time between an operator command via the operator interface to change an analog or binary point and the subsequent change in the controller shall be less than 5 seconds.
2. Object Scan. All changes of state and change of analog values will be transmitted over the network such that any data used or displayed at a controller or workstation will have been current within the previous 10 seconds.
3. Graphics Scan. The maximum time between an operator's selection of a graphic and it completely painting the screen and updating at least 10 points shall be less than 10 seconds.
4. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation or broadcast to pager (where so programmed) shall not exceed 10 seconds for a Level 1 or 2 alarm, 20 seconds for alarm levels 2 and 3, and 30 seconds for alarm levels 4 and 5. All workstations on the onsite network must receive alarms within 5 seconds of each other.
5. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The EMCS Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
6. Control Loop Performance. Programmable controllers shall be able to execute DDC PID control loops at a selectable frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.

## 1.12 OWNERSHIP OF PROPRIETARY MATERIAL

A. All project-developed software and documentation shall become the property of the Owner. These include, but are not limited to:

1. Project graphic images
2. Record drawings.
3. Project database.
4. Project specific application programming code.
5. All documentation.

## 1.13 WARRANTY

A. In accordance with Division 1 Guarantees, Warranties, Bonds, Service & Maintenance Contracts, and as follows.

B. At the successful completion of the final testing, commissioning, and demonstration phase in accordance with the terms of this specification, if equipment and systems are operating satisfactorily to the Owner and if all completion requirements per paragraph 1.07 have been fulfilled, the Owner shall certify in writing that the control system has been accepted. The date of acceptance shall be the start of the warranty period.

C. Guarantee all materials, equipment, apparatus, and workmanship (including programming) to be free of defective materials and faulty workmanship for period of one year from date of acceptance.

1. Valve and damper actuators shall carry a manufacturer’s 5-year warranty.

D. Provide new materials, equipment, apparatus, and labor to replace that determined by Owner to be defective or faulty.

E. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. The EMCS Contractor shall respond to the Owner's request for warranty service within 24 hours during normal business hours.

F. Operator workstation software, project-specific software, graphic software, database software, and firmware updates that resolve known software deficiencies as identified by the EMCS Contractor shall be provided at no charge during the warranty period. Software bugs (both due to programming misinterpretations and sequence errors) shall be corrected and any reasonable control sequence changes required to provide proper system operation shall also be provided at no additional cost during this period.

1.14 WARRANTY MAINTENANCE

A. The Owner reserves the right to make changes to the EMCS during the warranty period. Such changes do not constitute a waiver of warranty. The Contractor shall warrant parts and installation work regardless of any such changes made by the Owner unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the EMCS.

B. At no cost to the Owner, during the warranty period, the Contractor shall provide maintenance services for software and hardware components as specified below:

1. Maintenance services shall be provided for all devices and hardware specified in Division 23C. Service all equipment per the manufacturer’s recommendations.
2. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following telephonic notification by the Owner to the Contractor.
3. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following telephonic notification by the Owner to the Contractor.
4. Owner’s Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for Owner to call in the event of a need for service. At least one of the lines shall be attended continuously (24/7). Alternatively, pagers can be used for technicians trained in system to be serviced. One of the

three paged technicians shall respond to every call within 15 minutes.

5. Technical Support: Contractor shall provide technical support by telephone throughout the warranty period.
6. Preventive maintenance shall be provided throughout the warranty period in accordance with the hardware component manufacturer's requirements.
7. Record drawings and software documentation shall be updated as required to reflect any, and all changes made to the system or programming during the warranty period.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS (PRODUCT LINE)

A. Siemens (Desigo).

B. Trane (Tracer SC).

C. Schneider (SmartStruxture).

D. Or equal.

### 2.2 MATERIALS AND EQUIPMENT

A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way.

B. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

## PART 3 - EXECUTION

### 3.1 COORDINATION

A. The Contractor shall coordinate work schedule with Architect to complete project on schedule without disruption or delays.

B. The Contractor shall coordinate work with other trades prior to construction.

C. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

### 3.2 INSTALLATION

A. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.

B. Refer to additional requirements in other Sections of this specification.

## 3.3 DIGITAL CONTROL STATIONS

A. Individual Digital Control Stations referenced on drawings to indicate allocation of points to each DCS and DCS location. Digital control stations shall consist of one or multiple controllers to meet requirements of this specification. It is the Contractor's responsibility to provide enough controllers to ensure a completely functioning system, according to the point list and sequence of operations.

B. Where a DCS is referenced, Contractor shall provide at least one (1) controller, and additional controllers as required, in sufficient quantity to meet the requirements of this Specification. Restrictions in applying controllers are specified in Section 230919 - EMCS Field Panels.

C. Contractor is responsible for ensuring DCSs do not interfere with other requirements of the project and maintain adequate clearance for maintenance access.

D. DCSs have not been located. The Contractor shall locate DCSs in electrical rooms, mechanical rooms, and adjacent to rooftop equipment where space is available.

E. Contractor is responsible for ensuring DCSs do not interfere with other requirements of the project and maintain adequate clearance for maintenance access.

## 3.4 CONTROL POWER

A. Division 23C Contractor shall extend power to all EMCS devices, including 120V power to panels, from an acceptable power panel.

1. See Division 26 Electrical drawings for power locations pre-allocated for EMCS system.
2. Where no power source is shown, for bid purposes only, assume a dedicated circuit is available within an average of 50 feet of panel location. If this is not the case, request additional cost prior to submission of shop drawings or no additional costs will be reimbursed.
3. Coordinate with Division 26 during shop drawing development for final connection location.

B. General requirements for obtaining power include the following:

1. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120v source fed from a common origin.

2. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment's control transformer is large enough and of the correct voltage to supply the controls, it may be used. If the equipment's control transformer is not large enough or of the correct voltage to supply the controls, the Contractor shall provide separate transformer(s).
3. Where a controller, controls multiple systems on varying levels of power reliability (normal, emergency, and/or interruptible), the controller shall be powered by the highest level of reliability served.
4. Standalone Functionality: Refer to Section 230919.

C. Power line filtering. Provide transient voltage and surge suppression for all workstations and controllers either internally or as an external component.

## 3.5 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment.

B. Store equipment and materials inside and protect from weather.

## 3.6 IDENTIFICATION

A. General:

1. Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment is installed.
2. Identifiers shall match record documents.
3. All plug-in components shall be labeled such that removal of the component does not remove the label.

B. Wiring and Tubing:

1. All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 2" of termination with the DDC address or termination number.
2. Permanently label or code each point of field terminal strips to show the instrument or item served.
3. All pneumatic tubing shall be labeled at each end within 2" of termination with a descriptive identifier.

C. Equipment and Devices

1. Valve and damper actuators: Provide 2" diameter brass tags and brass chains. Lettering shall be 1/2" high, stamped and painted black. Indicate unique valve or damper identifier from record drawings.

2. Sensors: Provide 1"x 3"x 1/8" black micarta or lamacoid labels with engraved white lettering, ¼" high. Indicate sensor identifier and function (e.g. "CHWS temp").
3. Panels: Provide 2"x 5" 1/8" black micarta or lamacoid labels with engraved white lettering, ½" high. Indicate panel identifier and service.
4. Identify room sensors relating to terminal box or valves with indelible marker on sensor hidden by cover.

## 3.7 CUTTING, CORING, PATCHING & PAINTING

A. The EMCS Contractor shall provide canning for openings in concrete walls and floors and other structural elements prior to their construction. Should any openings be missed, the EMCS Contractor shall be responsible for all cutting, coring, and patching that may be required for Division 23C work. Structural elements shall not be cut without the written consent of Owner.

B. Penetrations through rated walls or floors shall be filled with an approved material to provide a code compliant firestop.

C. All damage to and openings in ductwork, piping insulation, and other materials and equipment resulting from Division 23C work shall be properly sealed, repaired, and/or re-insulated by experienced mechanics of the trade involved. Repair insulation to maintain integrity of insulation and vapor barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.

D. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired and repainted to original finish.

## 3.8 CLEANING

A. The EMCS Contractor shall clean up all debris resulting from its activities daily. The EMCS Contractor shall remove all cartons, containers, crates, etc., under its control as soon as their contents have been removed. Waste shall be collected and legally disposed of by EMCS Contractor.

B. The EMCS Contractor shall clean up all debris resulting from its activities daily. The EMCS Contractor shall remove all cartons, containers, crates, etc., under its control as soon as their contents have been removed. Waste shall be collected and legally disposed of by EMCS Contractor.

C. At the completion of work in any area, the EMCS Contractor shall clean all of its work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

D. The EMCS Contractor shall use only cleaning materials recommended by the manufacturer of the surfaces to be cleaned and on surfaces recommended by the cleaning material manufacturer.

3.9 FIELD QUALITY CONTROL

A. See Division1 Quality Control.

B. Perform tests as required by authorities having jurisdiction.

C. Repair or replace defective work, as directed by Architect in writing, at no additional cost to the Owner.

D. Restore or replace damaged work due to tests as directed by Architect in writing, at no additional cost to the Owner.

E. Restore or replace damaged work of others, due to tests, as directed by Architect in writing, at no additional cost to the Owner.

F. Remedial work shall be performed to the satisfaction of the Architect, at no additional cost to the Owner, including:

1. Work related to all Division 23C pre-functional, functional, and demonstration tests.
2. Division 23C work related to Section 230593 Testing, Adjusting and Balancing.

G. Remedial work shall include performing any commissioning or other tests related to remedial work an additional time at no additional cost to the Owner.

END OF SECTION

SECTION 23 09 13 – EMCS BASIC MATERIALS AND DEVICES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 WORK INCLUDED

A. Provide and install the following:

1. Field devices including control valves, control dampers, sensors, etc.

B. Refer to Section 230900 for general requirements.

C. Refer to drawings for points list and specific device requirements.

### 1.3 RELATED WORK AND REQUIREMENTS

A. Other EMCS Sections:

1. Section 230900 Energy Management and Control System (EMCS) - General
2. Section 230916 EMCS Operator Interfaces
3. Section 230919 EMCS Field Panels
4. Section 230923 EMCS Communication Devices
5. Section 230926 EMCS Software and Programming
6. Section 230933 EMCS Commissioning

### 1.4 GENERAL

A. Sensor selection, wiring method, use of transmitters, A-to-D conversion bits, etc. shall be selected and adjusted to provide end-to-end (fluid to display) accuracy at or better than those listed in the following table.

| Measured Variable | Reported Accuracy |
|---|---|
| Space dry bulb temperature | ±1°F |
| Ducted airdry bulb temperature | ±0.5°F |
| Mixed airdry bulb temperature | ±1°F |
| Water source heat pump / condenser water temperature - general | ±0.5°F |
| Relative humidity – general | ±5% RH |
| Air pressure (ducts) | ±0.05 inches |

| Measured Variable | Reported Accuracy |
|---|---|
| Air pressure (space) | ±0.01 inches |
| Water pressure | ±2% of full scale |
| Electrical power | 1% of reading |
| Carbon Dioxide ($CO_2$) | ±75 ppm |

B. The listing of several sensors or devices in each section of Part 2 does not imply that any may be used. Refer to points list on drawings for device specification. Only where two or more devices are specifically listed in points list (e.g. "FM-1 or FM-4") may the contractor supply any of the listed products.

## PART 2 - PRODUCTS

### 2.1 AIR TUBING

A. Seamless copper tubing, Type L-ACR, ASTM B 88; with cast-bronze solder joint fittings, ANSI B1.18; or wrought-copper solder joint fittings, ANSI B16.22; except brass compression-type fittings at connections to equipment. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder.

B. Virgin polyethylene non-metallic tubing type FR, ASTM D 2737, and with flame-retardant harness for multiple tubing. Use compression or push-on brass fittings.

### 2.2 ELECTRIC WIRING AND DEVICES

A. General. All electrical work shall comply with Division 26.

B. Power Wiring.

1. Power wiring and wiring connections required for EMCS shall be provided under this section unless specifically shown on drawings or specified to be under Division 26. See Coordination section in Section 230900.
2. See Control Power section of 230900.

C. Communication Wiring.

1. Contractor shall supply all communication wiring between Building Controllers, Routers, Gateways, AAC's, ASC's and local and remote peripherals (e.g., operator workstations, printers, and modems).
2. Supervisory LAN: For any portions of this network required under this section of the specification, contractor shall use Fiber or Category 5 of standard TIA/EIA 68 (10baseT). Network shall be run with no splices and separate from any wiring over thirty (30) volts.
3. Primary and Secondary Controller LANs: Communication wiring shall be individually 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any

wiring over thirty (30) volts. Shield shall be terminated, and wiring shall be grounded as recommended by BC manufacturer.

D. Signal Wiring.

1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gauge wire, with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.
2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

E. Low Voltage Analog Output Wiring.

1. Low voltage control wiring shall be minimum 16-gauge, twisted pair, 100% shielded, with PVC cover, Class 2 plenum-rated. Low voltage control wiring shall be run with no splices separate from any wiring above thirty (30) volts.

## 2.3 CONTROL CABINETS

A. All control cabinets shall be fully enclosed with hinged door, key-lock latch. A single key shall be common to all field panels and sub-panels within each building. Provide 3 keys.

B. Construction.

1. Indoor: NEMA-1.
2. Outdoor: NEMA 4.

C. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for service, individually identified per control/interlock drawings, with adequate clearance for field wiring. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover. Control terminations for field connection shall be individually identified per control drawings.

D. Provide ON/OFF power switch with over-current protection for control power sources to each local panel.

E. Provide with:

1. Framed, plastic-encased point list for all points in cabinet.
2. Nameplates for all devices on face.

## 2.4 CONTROL VALVES

A. Manufacturers:

1. Belimo
2. Siemens

3. Johnson Controls
4. Invensys
5. Delta
6. Or equal

B. Plug-Type Globe Pattern for Water Service:

1. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on 'top-and-bottom' guided plugs.
2. Temperature Rating: 25˚F minimum, 250˚F maximum.
3. Body:

    a. Bronze, screwed for 1/2" to 2".
    b. Cast Iron, flanged for 2-1/2" and larger.

4. Valve Trim: Bronze; Stem: Polished stainless steel.
5. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting.
6. Plug: Brass, bronze or stainless steel, Seat: Brass.
7. Disc: Replaceable Composition or Stainless Steel Filled PTFE.
8. Ambient Operating Temperature Limits: -10 to 150˚F.

C. Butterfly Type:

1. Body: Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class bolt pattern to match specified flanges.
2. Seat: EPDM replaceable, non-collapsible, phenolic backed.
3. Disc: Polished aluminum bronze or stainless steel pinned or mechanically locked to shaft. Sanded castings are not acceptable.
4. Bearings: Bronze or stainless steel.
5. Shaft: 416 stainless steel supported at three locations with PTFE bushings for positive shaft alignment.
6. Close Off: Bubble-tight shutoff at rated differential pressure.
7. Operation: Valve and actuator operation shall be smooth both seating and unseating. Should more than 2 psi deadband be required to seat/unseat the valve, valve shall be replaced at no additional cost to the Owner.
8. Manufacturers in Addition to those listed above:

    a. Jamesbury
    b. Keystone
    c. Dezurik
    d. Or equal

D. Characterized Ball Type:

1. Valves shall be specifically designed for modulating duty in control application with guaranteed average leak-free life span over 200,000 full stroke cycles.
2. Maximum size: 3 inch.
3. Industrial quality with nickel plated forged brass bronze bodies and female NPT threads.
4. Blowout proof stem design, glass-reinforced Teflon thrust seal washer and stuffing box ring with minimum 600 PSI rating (two-way valves) or 400 PSI rating (three way valves). The stem packing

shall consist of 2 lubricated O-rings designed for on-off, floating, or modulating service and requiring no maintenance.

5. Valves suitable for water or low-pressure steam shall incorporate an anti-condensation cap thermal break in stem design.
6. Ball: stainless steel.
7. Stem: stainless steel.
8. Port: Segmented design with characterizing disk held securely by a keyed ring.

E. Valve assembly pressure ratings:

1. Chilled water: 125 psi at 60˚F.
2. Hot water: 125 psi at 200˚F.
3. Condenser water. 125 psi at 60˚F.

F. Valve Selection:

1. Valve type:

a. Modulating 2-way or 3-way valves: globe or characterized ball type. Butterfly valves may also be used for applications requiring low valve authority (pressure drop 1 psi and less) such as cooling tower bypass and boiler bypass. Valves (in conjunction with actuator) shall have minimum rangeability of 100 to 1.

1) 3 inch and less: characterized ball type.
2) 4 inch and greater: globe type.

b. Two-position: butterfly or ball valves.

2. Valve Characteristic:

a. 2-way valves: equal percentage or modified equal percentage.
b. 3-way valves controlling cooling coils and condenser water heat exchangers: linear.
c. 3-way valves controlling heating coils: equal percentage or modified equal percentage.
d. Two-position valves: not applicable.

3. Valve Sizing:

a. Modulating Water: Size valve to achieve the following full-open pressure drop:

1) Minimum pressure drop: equal to pressure drop of coil or exchanger.
2) Maximum pressure drop:

a) Hot and chilled water at bridge connection: 2 psi.
b) Hot water at coils: 2 psi.
c) Chilled water at coils: 5 psi.
d) Tower bypass: 1 psi.
e) Boiler bypass: 1 psi.

3) Three-way valves shall be selected for near minimum pressure drop. Two-way valves shall be selected near maximum pressure drop.
4) Flow coefficient ($C_v$) shall not be less than 1.0 (to avoid clogging).

b. Two-position valves: Line size unless otherwise indicated.

## 2.5 CONTROL DAMPERS

A. See Section 233300 Air Duct Accessories.

## 2.6 ACTUATORS

A. Manufacturers:

1. Belimo
2. Siemens
3. Johnson Controls
4. Delta
5. Invensys
6. Or equal

B. Warranty: Valve and damper actuators shall carry a manufacturer's 5-year warranty.

C. Electric Actuators.

1. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.
2. Dampers. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The clamp shall be steel of a "V" bolt design with associated "V" shaped, toothed cradle attaching to the shaft for maximum strength and eliminating slippage via cold weld attachment. Single bolt or set screw type fasteners are not acceptable. Aluminum clamps are unacceptable.
3. Valves. Actuators shall be specifically designed for integral mounting to valves without external couplings.
4. Actuator shall have microprocessor-based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible.
5. Actuators shall provide protection against actuator burnout using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation or use of magnetic clutches are not acceptable.
6. Modulating actuators:

a. General: Actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. Actuators shall have positive positioning

circuit so that controlled device is at same position for a given signal regardless of operating differential pressure.

7. Where shown on Drawings or Points List, actuators shall include:

   a. 2 to 10 VDC position feedback signal.
   b. Limit (end) position switches.

8. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA.
9. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
10. Actuators shall be provided with a conduit fitting and a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
11. Where fail-open or fail-closed position is required, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe are not acceptable. All spring return actuators shall be capable of both, clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
12. Actuators shall be capable of being mechanically and electrically paralleled to increase torque where required.
13. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
14. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed.
15. Provide limit (end) position switches, where indicated on schematics.

D. Electric Actuators for Large Butterfly Valves.

1. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.
2. The valve actuator shall consist of a capacitor-type reversible electric motor, gear train, limit switches and terminal block, all contained in a die cast aluminum enclosure.
3. Enclosure shall meet NEMA 4 weatherproof requirements for outdoor applications. Unless NEMA-3R indicated elsewhere.
4. Output shaft shall be electroless nickel plated to prevent corrosion.
5. Actuator shall have a motor rated for minimum 75% duty cycle. Duty cycle shall be defined as running time / Installed time at maximum torque.
6. Actuator shall be suitable for operation in ambient temperature ranging from -22˚F to +150˚F.
7. A pre-wired cable shall bring wiring outside enclosure to avoid necessity of opening cover.
8. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.

9. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator. When in manual operation electrical power to the actuator will be permanently interrupted.
10. The hand wheel will not rotate while the actuator is electrically driven.
11. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.
12. Provide limit (end) position switches, where indicated on schematics.

E. Normal Position. Actuators shall be spring return to the normal position unless non-spring style is specifically listed as acceptable in table below. Except as specified otherwise, "normal" positions of control devices shall be as follows:

| Device | Normal Position | Spring Return Required |
|---|---|---|
| Outside air damper | CLOSED | Yes |
| Return air damper | OPEN | Yes |
| Exhaust/relief air damper | CLOSED | Yes |
| AHU heating coil valves | OPEN | |
| AHU cooling coil valves | CLOSED | |
| Equipment isolation valves: | OPEN | |
| Hot water re-heat coil valves | CLOSED | |
| Fan coil HW and CHW valves | CLOSED | |

F. Valve Actuator Selection:

1. Modulating actuators for valves shall have minimum rangeability of 50 to 1.
2. Water:

    a. Two way and two-position valves:

        1) Tight closing against 125 percent of system pump shut-off head.
        2) Modulating duty against 90 percent of system pump shut-off head.

    b. Three-way shall have close-off against twice the full open differential pressure for which they are sized.

G. Damper Actuator Selection:

1. Actuators shall be direct coupled. For multiple sections, provide one actuator for each section; linking or jack-shafting damper sections shall not be allowed.
2. Provide sufficient torque as velocity, static, or side seals require per damper manufacturer's recommendations and the following.

    a. Torque shall be a minimum 5 in-lb. per sq. ft. for opposed blade dampers and 7 in-lb. per sq. ft. for parallel blade dampers.

b. The total damper area operated by an actuator shall not exceed 80% of the manufacturer's maximum area rating.

## 2.7 GENERAL FIELD DEVICES

A. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers, and as required for proper operation in the system.

B. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.

C. Field devices specified herein are generally 'two-wire' type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power or is not designed to work with 'two-wire' type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide 'four-wire' type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.

D. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.

E. Accuracy: As used in this Section, accuracy shall include combined effects of nonlinearity, non-repeatability, and hysteresis. Sensor accuracy shall be at or better than both that specifically listed for a device and as required herein.

## 2.8 TEMPERATURE SENSORS (TS)

A. General:

1. Unless otherwise noted, sensors may be platinum RTD, thermistor, or other device that is commonly used for temperature sensing and that meets accuracy, stability, and resolution requirements.
2. When matched with A/D converter of BC, AAC, or ASC, sensor range shall provide a resolution of no worse than 0.3°F (unless noted otherwise).
3. Sensors shall drift no more than 0.3°F and shall not require calibration over a five-year period.
4. Manufacturers:

    a. Mamac.
    b. Kele Associates
    c. Building Automation Products
    d. Or equal

B. Duct temperature sensors. Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Sensor probe shall be 316 stainless steel.

1. TS-1A. Single point (use where not specifically called out to be averaging in points list).
2. TS-1B. Averaging. Sensor length shall be at least 1 linear foot for each 3 square feet of face area up to 25 feet maximum.

C. Water temperature sensors.

1. TS-2A: Immersion sensors. All piping immersion sensors shall be in brass or stainless-steel wells that allow removal from operating system, with lagging extension equal to insulation thickness, where installed in insulated piping. Wells shall be rated for maximum system operating pressure, temperature, and fluid velocity. The well shall penetrate the pipe by the lesser of half the pipe diameter or four inches. The use of direct immersion or strap-on type sensors is not acceptable.
2. TS-2B. Same as TS-2A except provide matched temperature sensors for differential temperature measurement, e.g. chilled water supply and return temperature.
3. TS-2C. Same as TS-2A or TS-2B (matched pair) with the following added requirements (for extremely high accuracy and stability at central plant main supply/return chilled water temperature sensors): Each assembly shall consist of a 100 Ohm platinum RTD and a solid-state 4-wire, 4-20mA transmitter contained in a housing suitable for pipe mounting, spring-loaded probe to ensure good thermal contact between the sensor and the well. Manufacturer must be certified as meeting the requirements of ISO 9001. RTD shall conform to the DIN 437601980 standards (Ultra precision DIN RTD). 2 Year NIST traceable guarantee. Manufacturer: Accutech AI-2000, or equal.

D. Room sensors: Shall be an element contained within a ventilated cover, suitable for wall mounting, with insulated base.

1. TS-3A.

    a. Thermistor in enclosure with blank cover.
    b. Include a USB port for connection of portable Operator Interface.

2. TS-3B. Same as TS-3A except.

    a. Setpoints shall be adjustable at wall mounted sensor with setpoint knobs with software limits.
    b. Override button capable of being programmed to start system during unscheduled hours.

3. TS-3C. Same as TS-3B except.

    a. Integral LCD display of space temperature and active setpoint.

4. Unless otherwise indicated in points list, locate sensors as follows:

    a. Lobbies, corridors, break rooms, and other public spaces: TS-3B.
    b. Equipment rooms: TS-3A
    c. Offices and other spaces not listed above: TS-3C.
    d. Others not listed: Confirm with Architect through RFI.

E. TS-4. Outdoor air sensors shall have a sun shield, utility box, and watertight gasket to prevent water seepage.

F. Temperature Transmitters. Where required by Controller, or to meet specified end-to-end accuracy requirements, sensors as specified above shall be matched with transmitters outputting 4-20 mA linearly across the specified temperature range. Transmitters shall have zero and span adjustments, an accuracy of 0.1˚F when applied to the sensor range.

## 2.9 HUMIDITY TRANSMITTERS (HT)

A. General:

1. Suitable for duct, wall (room) or outdoor mounting as indicated in points list and Construction Drawings.
2. Two-wire transmitter utilizing bulk polymer resistance change or thin film capacitance change humidity sensor producing a continuous 4-20 mA output proportional to percent relative humidity (%RH).
3. Input Range: 0 to 100% RH.
4. Accuracy (%RH), NIST Traceable and certified at 77˚F over 20-95% RH including hysteresis, linearity, and repeatability:

    a. HT-1: ±2%
    b. HT-2: ±3%

5. Sensor Operating Range:

    a. Humidity: 0-99%, non-condensing, sensor.
    b. Temperature: 32˚F to 122˚F

6. Temperature Effect: Less than 0.06% per ˚F at baseline of 77˚F.
7. Sensitivity: 0.1% RH.
8. Repeatability: 0.5 RH.
9. Hysteresis: Less than 1%.
10. Long Term Stability: Less than 2% drift per 5 years.
11. Manufacturer:

    a. Vaisala HM Series
    b. Automation Components Inc. RH Series
    c. Or equal

## 2.10 $CO_2$ SENSORS/TRANSMITTERS (CO2)

A. CO2-1. Wall mounted.

1. Non-dispersive infrared sensor with dual beam technology where a reference channel is used to maintain sensor calibration.
2. Detachable base with all field wiring terminations on base.
3. Accuracy: ±50 ppm or 5% of reading from 0 to 1500 ppm at temperatures from 60˚F to 90˚F.
4. Factory calibrated and set to 0-2000 ppm range (equals 4-20 mA or 0-10 V).
5. Include elevation adjustment.
6. The sensor shall not require recalibration for a minimum of 5 years, guaranteed. If sensor is found to be out of calibration, supplier shall recalibrate at no additional cost to the Owner within 5 years of purchase date.
7. LCD display.
8. Manufacturers:

    a. Telaire 8102
    b. Vaisala GMV21
    c. AirTest EE80-2CT
    d. Or equal

B. CO2-2. Same as CO2-1 except duct mounted.

## 2.11 DIFFERENTIAL PRESSURE TRANSMITTERS (DPT)

A. DPT-1. Water, General Purpose.

1. Fast-response capacitance sensor.
2. Two-wire transmitter, 4-20 mA output with zero and span adjustments.
3. Accuracy.

    a. Overall Accuracy (at constant temp) ±0.25% full scale (FS).
    b. Non-Linearity, BFSL ±0.20% FS.
    c. Hysteresis 0.10% FS.
    d. Non-Repeatability 0.05% FS.

4. Long Term Stability 0.5% FS per year.
5. Only 316 stainless steel in contact with fluid.
6. Pressure limits.

    a. 0 to 100 psid range: 250 psig maximum static pressure rating, 250 psig maximum overpressure rating.
    b. 100 to 300 psid range: 450 psig maximum static pressure rating, 450 psig maximum overpressure rating.

7. Include brass 3-valve assembly. See sensor installation specifications below.
8. Manufacturers:

    a. Setra 230
    b. Modus W30
    c. Or equal

B. DPT-2. Air, Duct Pressure:

1. General: Loop powered two-wire differential capacitance cell-type transmitter.
2. Output: two wire 4-20 mA output with zero adjustment.
3. Overall Accuracy: ±1% scale.
4. Minimum Range: 0.5 in. w.c.
5. Maximum Range: 10 inches w.c.
6. Housing: Polymer housing suitable for surface mounting.
7. Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301, Davis Instruments, or equal and connecting tubing.
8. Range: Select as specified in points list or, if not listed for specified setpoint to be between 25% and 75% full-scale.
9. DPT-2A: Include LCD display of reading.
10. Manufacturers:

    a. Veris
    b. Setra
    c. Modus
    d. Invensys
    e. Dwyer
    f. Or equal

## 2.12 DIFFERENTIAL PRESSURE SWITCHES (DPS)

A. DPS-1. Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range. 0˚F to 160˚F operating temperature range.

B. DPS-2. Air: Diaphragm with adjustable setpoint and differential and snap acting form C contacts rated for the application. Provide manufacturer's recommended static pressure sensing tips and connecting tubing.

## 2.13 WATER LEAK DETECTOR (WLD)

A. WLD-1:

1. Gold plated adjustable sensing probes to detect water from 0 to 1/8 inch above surface.
2. All electronic circuitry encapsulated in epoxy to protect from dirt, fungus, and short-term immersion in water.
3. DPDT (2 form C) relay contact outputs rated at 1 amp @ 28 VDC.
4. Powered with 12-24 VAC or VDC from EMCS panel. Battery not acceptable.
5. 5-year warranty minimum.
6. Manufacturer:

    a. Dorlen Water Alert SS-4’
    b. Or equal

2.14 CURRENT SWITCHES (CS)

A. CS-1

1. Clamp-on or solid-core
2. Range: 1.5 to 150 amps (or as required by application).
3. Trip Point: Adjustable.
4. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
5. Lower Frequency Limit: 6 Hz.
6. Trip Indication: LED
7. Approvals: UL, CSA
8. May be combined with relay for start/stop.
9. Where used for single-phase devices, provide the CS/CR in a self-contained unit in a housing with override switch. Kele RIBX, Veris H500, or equal.
10. Manufacturers:

    a. Veris Industries H-608/708/808/908; Inc.
    b. RE Technologies SCS1150A-LED
    c. Or equal

2.15 CURRENT TRANSFORMER (CT)

A. Clamp-On Design Current Transformer (for Motor Current Sensing)

1. Range: 1-10 amps minimum, 20-200 amps maximum.
2. Trip Point: Adjustable.
3. Output: 0-5 VDC.
4. Accuracy: ±0.2% from 20 to 100 Hz.
5. Manufacturers:

    a. Kele SC100
    b. Veris 722
    c. Or equal

2.16 ELECTRONIC CONTROL COMPONENTS

A. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley, or equal.

B. Line-Voltage Wall Thermostat: Wall-mounted thermostat shall consist of SPDT contacts rated for 120V and current as required for application, temperature setpoint range of 50 to 95□ F, and an adjustable 2-10□F setpoint differential.

C. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA-1 enclosure for indoor locations, NEMA-4 for outdoor locations.

1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:

a. AC coil pull-in voltage range of +10%, -15% or nominal voltage.
b. Coil sealed volt-amperes (VA) not greater than four (4) VA.
c. Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
d. Pilot light indication of power-to-coil and coil retainer clips.

2. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load.
3. Relays used for stop/start control shall have low voltage coils (30 VAC or less) and shall be provided with transient and surge suppression devices at the controller interface.

D. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA type 1enclosure. Manufacturer shall be Square 'D', Cutler-Hammer, or equal.

E. Control Transformers and Power Supplies:

1. Control transformers shall be UL Listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements. Mount in minimum NEMA-1 enclosure.
2. Transformer shall be proper size for application. Limit connected loads to 80% of rated capacity.
3. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100 microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand a 150% current overload for at least 3 seconds without trip-out or failure.
4. Unit shall operate between 0°C and 50°C [32°F and 120°F]. EM/RF shall meet FCC Class B and VDE 0871 for Class B, and MIL-STD 810C for shock and vibration.
5. Line voltage units shall be UL Recognized and CSA Approved.

F. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley, Kele, or equal.

G. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, 120 Vac Sonalert solid-state electronic signal, as manufactured by Mallory, Kele, or equal.

H. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen-Bradley, Kele, or equal.

## PART 3 - EXECUTION

### 3.1 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

### 3.2 INSTALLATION

A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings. Install electrical components and use electrical products complying with requirements of National Electric Code and all local codes.

### 3.3 ELECTRICAL INSTALLATION

A. Wiring.

1. Comply with Division 26.
2. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC requirements and shall be installed by a licensed electrician.
3. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.) Class 2 wiring shall be installed in UL Listed approved raceway, except where wires are in concealed in accessible locations, approved cables not in raceway may be used, provided that cables are UL Listed for the intended application. For example, cables used in ceiling return plenums shall be UL Listed specifically for that purpose.
4. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
5. Do not install wiring in raceway containing tubing.
6. Where Class 2 wiring is used without raceway, it shall be supported from or anchored to structural members neatly tied at 10 foot intervals. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems and at least 1 foot above ceiling tiles and light fixtures.
7. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
8. All field wiring shall be properly labeled at each end, with self-laminating typed labels indicating device address, for easy reference to the identification schematic. All power wiring shall be neatly labeled to indicate service, voltage, and breaker source.
9. Use coded conductors throughout with different colored conductors.

10. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
11. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the Contractor shall provide step-down transformers.
12. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
13. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
14. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendation and NEC requirements.
15. Include one pull string in each raceway 1 inch or larger.
16. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
17. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6” from high-temperature equipment (e.g., steam pipes or flues).
18. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
19. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
20. The EMCS Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
21. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 feet in length and shall be supported at each end. Flexible metal raceway less than ½” electrical trade size shall not be used. In areas exposed to moisture liquid-tight, flexible metal raceways shall be used.
22. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations must be made with fittings at boxes and ends not terminating in boxes shall have bushings installed.
23. Electrical service to controls panels and control devices shall be provided by isolated circuits, with no other loads attached to the circuit, clearly marked at its source. The location of the breaker shall be clearly identified in each panel served by it. If a spare breaker is not available within an electrical panel, the EMCS Contractor shall be responsible for providing any and all equipment and labor necessary to supply an isolated circuit. Controllers controlling only packaged air conditioning equipment may be powered directly from the packaged units control circuit.
24. Wire digital outputs to either the normally-closed or normally-open contacts of binary output depending on desired action in case of system failure. Unless otherwise indicated, wire to the NO contact except the following shall be wired to the NC contact:

    a. Hot water pumps.
    b. Coil recirc’ pumps provided for freeze protection.

25. Hardwire Interlocks.

    a. The devices referenced in this section are hardwire interlocked to ensure equipment shutdown occurs even if control systems are down. Do not use software (alone) for these interlocks.
    b. Hardwire device NC contact to air handler fan starter upstream of HOA switch, or to VFD enable contact.
    c. Where multiple fans (or DDC DI) are controlled off of one device and the device does not have sufficient contacts, provide a relay at the device to provide the required number of contacts.
    d. Provide for the following devices, where shown on plans:

        1) Duct smoke detector.
        2) High discharge static pressure.
        3) Low mixing plenum pressure.
        4) Freeze-stats.

B. Communication Wiring.

1. The EMCS Contractor shall adhere to the requirements of paragraph 3.3A in addition to this section.
2. Communication and signal wiring may be run without conduit in concealed, accessible locations as permitted by paragraph 3.3A only if noise immunity is ensured. Contractor will be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance.
3. All cabling shall be installed in a neat and workmanlike manner. Follow all manufacturers' installation recommendations for all communication cabling. Use shielded wiring if recommended by manufacturer.
4. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
5. Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.
6. EMCS Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
7. All runs of communication wiring shall be un-spliced length when that length is commercially available.
8. All communication wiring shall be labeled to indicate origination and destination data.
9. Grounding of coaxial cable shall be in accordance with NEC regulations Article on Communications Circuits, Cable and Protector Grounding.
10. Shielded cable shield shall be grounded only at one end.
11. Power-line carrier signal communication/transmission is not acceptable.

## 3.4 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

C. Temperature Sensors.

1. Room temperature sensors/thermostats shall be installed on concealed junction boxes properly supported by the wall framing.
2. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
3. Averaging sensors shall be installed in a serpentine manner vertically across duct. Each bend shall be supported with a capillary clip. Where located in front of filters (e.g. mixed air sensors), access for filter removal shall be maintained.
4. For sensors specified to be calibrated using a dry well bath (see points list), install sensors with a sufficient wiring/flexible conduit lead that sensor may be removed from well or duct and placed in an ice bath or dry well for calibration. The spare wiring/flexible conduit shall be no less than 3’ in length.
5. All pipe-mounted temperature sensors shall be installed in wells. Install the sensor in the well with a thermal-conducting grease or mastic. Use a closed-cell insulation patch that is integrated into the pipe insulation system to isolate the top of the well from ambient conditions but allow easy access to the sensor. Install a test plug adjacent to all wells for testing and calibration.
6. Unless otherwise noted, temperature sensors/thermostats, humidity sensors/humidistats, $CO_2$ sensors, and other room wall mounted sensors shall be installed at same centerline as adjacent electrical switches, 4’-0” above the finished floor where there are no adjacent electrical switches, and within ADA limitations.
7. Unless otherwise noted, install outdoor air temperature sensors on north wall, complete with sun shield, where they will not be influenced by building exhaust, exfiltration, or solar insolation. Do not install near intake or exhaust air louvers.

D. Differential Pressure Sensors.

1. Supply Duct Static Pressure: Locate transmitter in temperature control panel near or in DDC panel to which it is wired. Connect the low-pressure port to tee in building pressure (high) signal of the building static pressure transmitter. Pipe the high-pressure tap to the duct using a static pressure tip. Locate static pressure tip as shown on drawings; if no location is shown, locate at end of duct riser or main as far out in the system as possible but upstream of all smoke and fire dampers. Install pressure tips securely fastened with tip facing upstream in accordance with manufacturer’s installation instructions.
2. Filter Differential Pressure:

    a. Install static-pressure tips upstream and downstream of filters with tips oriented in direction of flow.
    b. Mount transmitter on outside of filter housing or filter plenum in an accessible position with LCD display clearly visible. This sensor is used in lieu of an analog gauge and thus must be readily viewable.

3. Building Static Pressure:

    a. Low pressure port of the pressure sensor:

        1) Pipe to the ambient static pressure probe located on the outside and at high point of the building through a high-volume accumulator or otherwise protected from wind fluctuations.

    b. High-pressure port of the pressure sensor:

        1) Pipe to either:

            a) Behind a DDC temperature sensor cover in an interior zone.
            b) Bosco or Dwyer plate sensor mounted in ceiling.

        2) Do not locate near elevators, exterior doors, atria, or (for ceiling sensor applications) near diffusers.

4. All pressure transducers, other than those controlling VAV boxes, shall be located where accessible for service without use of ladders or special equipment. If required, locate in field device panels and pipe to the equipment monitored or ductwork.
5. The piping to the pressure ports on all pressure transducers (both air and water) shall contain a capped test port located adjacent to the transducer.
6. Piping differential pressure transducers shall have three valve manifold, two valves to allow removal of sensor without disrupting the hydronic system plus an equalizing valve to allow the sensor to be zeroed and to prevent sensor from experiencing full static (as opposed to differential) pressure, plus test plugs on each connection (also used as vents).
7. Copper tubing shall be installed in a neat manner (parallel and perpendicular to the building structure, equipment, piping, etc. from which it is supported) and shall be properly supported. Changes to copper tubing installation resulting from failure to comply with this requirement shall be made at the discretion of the Architect at no additional cost to the Owner.

E. Relative Humidity Sensors: Provide element guard as recommended by manufacturer for high velocity installations. For high limit sensors, position remote enough to allow full moisture absorption into the air stream before reaching the sensor.

F. Flow Switches: Install in a straight run of pipe at least 10 diameters in length to minimize false indications.

G. Current Switches for Motor Status Monitoring: Adjust so that setpoint is below minimum operating current and above motor no load current.

H. Airflow Measuring Stations: Install per manufacturer’s recommendations in an unobstructed straight length of duct both upstream and downstream of sensor, except those installations specifically designed for installation in fan inlet. For installations in fan inlets,

provide on both inlets of double inlet fans and provide inlet cone adapter as recommended by AFMS manufacturer.

I. Fluid Flow Sensors: Install per manufacturer's recommendations in an unobstructed straight length of pipe both upstream and downstream of sensor.

## 3.5 ACTUATORS

A. Type.

1. Actuators for two-position valves may be pneumatic or electric at the option of the Division 23C contractor.
2. Actuators for high pressure (125 psig) steam, both modulating and two-position, shall be pneumatic.
3. Except where listed above, actuators shall be electric.

B. Mount and link control damper actuators per manufacturer's instructions.

C. Dampers:

1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage, or follow manufacturer's instructions to achieve same effect.
2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
3. Provide all mounting hardware and linkages for actuator installation.

D. Control Valves: Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, install with valve stem axis vertical, with operator side up. Where vertical stem position is not possible, or would result in poor access, valves may be installed with stem horizontal. Do not install valves with stem below horizontal, or down.

END OF SECTION

SECTION 23 09 16 – EMCS OPERATOR INTERFACES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 WORK INCLUDED

A. Integration of new EMCS into existing operator interfaces:

1. Operator Workstation(s)
2. Servers

B. Refer to Section 230900 for general requirements.

### 1.3 RELATED WORK AND REQUIREMENTS

A. Other EMCS Sections:

1. Section 230900 Energy Management and Control System (EMCS) - General
2. Section 230913 EMCS Basic Materials and Devices
3. Section 230919 EMCS Field Panels
4. Section 230923 EMCS Communication Devices
5. Section 230926 EMCS Software and Programming
6. Section 230933 EMCS Commissioning

## PART 2 - PRODUCTS

### 2.1 OPERATOR WORKSTATION (OWS)

A. Existing to be reused.

B. Integrate new EMCS into existing OWS.

C. Upgrade hardware and software as required.

### 2.2 CONTROL SYSTEM SERVER (CSS)

A. Existing to be reused.

B. Integrate new EMCS into existing CSS.

C. Upgrade hardware and software as required.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Upgrade and/or install new hardware and software as required to integrate new EMCS into existing OWS and CSS.

B. Install all hardware and software and configure all devices in accordance with manufacturer's instructions.

C. Provide all licenses, keys, etc. and all documentation and information required to install, configure, operate, diagnose, and maintain the system shall be provided.

D. Network connections:

1. See System Architecture in Section 230900.
2. Connect OWSs and CSS to Supervisory LAN.
3. Connect OWSs and CSS to Owner's IT WAN/LAN. Contractor shall coordinate with the Owner's IT representative to establish IP addresses and communications parameters to assure proper operation.

END OF SECTION

SECTION 23 09 19 – EMCS FIELD PANELS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 WORK INCLUDED

A. Provide and install the following:

1. Building Controller (BC)
2. Advance Application Specific Controller (AAC)
3. Application Specific Controller (ASC)

B. Refer to Section 230900 for general requirements.

### 1.3 RELATED WORK AND REQUIREMENTS

A. Other EMCS Sections:

1. Section 230900 Energy Management and Control System (EMCS) - General
2. Section 230913 EMCS Basic Materials and Devices
3. Section 230916 EMCS Operator Interfaces
4. Section 230923 EMCS Communication Devices
5. Section 230926 EMCS Software and Programming
6. Section 230933 EMCS Commissioning

## PART 2 - PRODUCTS

### 2.1 GENERAL

A. Point information from any controller (including BCs, AACs, and ASCs) and from any gateway shall be capable of being used in a control sequence in any other panel. The use of OWS or CSS to serve as a communications server between control panels and gateways is not acceptable.

B. For all controllers, operating configuration and software shall be retained in the event of a power outage without requiring a download from upper-level controllers by one or a combination of the following:

1. Volatile RAM shall have a replaceable battery backup using a lithium battery with a rated service life of 10,000 hours continuous, and a rated shelf life of at least 7 years.
2. Volatile RAM shall have a automatically rechargeable battery backup using a lithium battery with a rated service life of 50 hours continuous, and a rated shelf life of at least 10 years.
3. EEPROM, EPROM, or NOVROM non-volatile memory.

C. Controllers shall allow independent operation regardless of the status of the other controllers or OWS or CSS. All energy management logic shall reside in field hardware and shall not be dependent on the OWS or CSS for operation.

D. Each controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

1. Assume a predetermined failure mode.
2. Generate an alarm notification to the master controller and/or Operator Workstation.

E. All input points and output points shall be protected such that shorting of the point to itself — to another point, or to ground — will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

F. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at 0°F to 150°F.
2. Controllers used in conditioned space shall be mounted in dust--resistant enclosures, and shall be rated for operation at 32°F to 120°F.

G. Programmability. All controllers, including BCs, AACs, and ASCs, shall be fully user programmable. See Section 230926. Configurable pre-programmed logic shall not be acceptable in any controller. (This is required due to non-standard control sequences at AHUs and VAV terminal units.)

## 2.2 STAND-ALONE FUNCTIONALITY

A. General: These requirements clarify the requirement for stand-alone functionality relative to packaging I/O devices with a controller. Stand-alone functionality is specified with the controller and for each Application Category specified in Part 3. This item refers to acceptable paradigms for associating the points with the processor.

B. Functional Boundary: Provide controllers so that all points associated with and common to one unit or other complete system/equipment shall reside within a single control unit. The boundaries of a standalone system shall be as dictated in the contract documents. Generally,

systems specified for the Application Category will dictate the boundary of the standalone control functionality. See related restrictions below. When referring to the controller as pertains to the standalone functionality, reference is specifically made to the processor. One processor shall execute all the related I/O control logic via one operating system that uses a common programming and configuration tool.

C. The following configurations are considered acceptable with reference to a controller's standalone functionality:

1. Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).
2. Controllers with processors and modular back planes that allow plug in point modules as an integral part of the controller.
3. I/O point expander boards, plugged directly into the main controller board to expand the point capacity of the controller.

D. The following configurations are considered unacceptable with reference to a controller's standalone functionality:

1. Multiple controllers enclosed in the same control panel to accomplish the point requirement.

## 2.3 BUILDING CONTROLLER (BC)

A. General Requirements:

1. BCs shall be peer-to-peer devices connected to the Primary Controller LAN.
2. Each BC shall be capable of standalone direct digital operation utilizing its own microprocessor, internal RAM, non-volatile memory, input/output, wiring terminal strips, A/D converters, real-time clock/calendar and voltage transient and lightning protection devices, battery backup, regulated power supply, power conditioning equipment, ports for connection of operating interface devices, and control enclosure. Refer to standalone functionality specified above.
3. The BC(s) shall provide fully distributed control independent of the operational status of the OWSs and CSS. All necessary calculations required to achieve control shall be executed within the BC independent of any other device.
4. BCs shall perform overall system coordination, accept control programs, perform automated HVAC functions, control peripheral devices, and perform all necessary mathematical and logical functions. BCs shall share information with the entire network of BCs and AACs/ASCs for full global control. Each controller shall permit multi-user operation from multiple workstations and portable operator terminals connected either locally or over the Primary Controller LAN.
5. BC shall contain sufficient memory for all specified global control strategies, user defined reports and trending, communication programs, and central alarming.

6. The BC may provide for point mix flexibility and expandability. This requirement may be met via either a family of expander boards, modular input/output configuration, or a combination thereof. Refer to stand alone functionality specified above.
7. All BC point data, algorithms and application software shall be configurable, and all control strategies performed by the BC shall be both operator definable and modifiable, from Operator Interfaces. The point database and all application programs shall be stored in non-volatile, or battery backed volatile memory within the BC and will be able to upload/download to/from the OWS and/or CSS.
8. BC shall provide buffer for holding alarms, messages, trends etc.
9. Each BC shall include self-test diagnostics, which allow the BC to automatically alarm any malfunctions, or alarm conditions that exceed desired parameters as determined by programming input.
10. Each BC shall contain software to perform full DDC/PID control loops.
11. Memory:

    a. Memory for data trending shall reside in BCs; the Operator Workstation shall not need to be connected for data trending to occur. Memory shall be large enough to record 256 records of each hardware point on the panel and an equal number of software points, each record to include both data value and time of occurrence. (See Section 230926 for trending software requirements.)
    b. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of approximately 25% of available memory free for future programming changes.
    c. Provide an additional BC if needed to comply with this section.

12. For systems requiring end-of-line resistors those resistors shall be located in the BC.
13. Input-Output Processing:

    a. Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 0.5 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and a supervised manual hand off or auto (HOA) switch to allow for override. HOA override switches shall be monitored via additional input channels to provide dynamic indication of the switch status at any Operator Interface. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.
    b. Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10 Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the BC's board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 12 bits.

c. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board. Software multiplexing of an AI and resistors is unacceptable.
d. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
e. Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog is not acceptable. D/A converters shall have a minimum resolution of 8 bits. Each output shall have an LED to indicate the operating mode of the output and a supervised manual hand off or auto (HOA) switch and trim potentiometer to allow for override and manual positioning of the output from 0 to 100%. HOA override switches shall be monitored via additional input channels to provide dynamic indication of the switch status at any Operator Interface.
f. Analog Output Pneumatic (AOP), 0-20 psi: Pneumatic outputs via an I/ or V/P transducer. Multiplexed digital to pneumatic transducers are acceptable provided they are supplied as a standard product and part of the BC and provide individual feedback. Multiplexed pneumatic outputs of a separate manufacturer are unacceptable.
g. Pulsed Inputs: Capable of counting up to 8 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.

14. A communication port for operator interface through a terminal shall be provided in each BC. It shall be possible to perform all program and database back-up, system monitoring, control functions, and BC diagnostics through this port. Standalone BC panels shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers, or workstations.
15. Each BC shall be equipped with loop tuning algorithm for precise proportional, integral, derivative (PID) control. Loop tuning tools provided with the Operator Workstation software is acceptable. In any case, tools to support loop tuning must be provided such that P, I, and D gains are automatically calculated.
16. All analog output points shall have a selectable failure setpoint. The BC shall be capable of maintaining this failure setpoint in the event of a system malfunction, which causes loss of BC control, or loss of output signal, as long as power is available at the BC. The failure setpoint shall be selectable on a per point basis.
17. Slope intercepts and gain adjustments shall be available on a per-point basis.
18. BC Power Loss:

    a. Upon a loss of power to any BC, the other units on the primary controlling network shall not in any way be affected.
    b. Upon a loss of power, all software, database parameters, and data (except trend data) shall be protected from memory loss as described herein.

c. Upon restoration of power within the specified battery backup period, the BC shall resume full operation without operator intervention. The BC shall automatically reset its clock such that proper operation of any time dependent function is possible without manual reset of the clock. All monitored functions shall be updated.
d. Should the duration of a loss of power exceed the specified battery back-up period or BC panel memory be lost for any reason, the panel shall automatically report, or CSS shall automatically determine, the condition (upon resumption of power) and be capable of receiving a download via the network, and connected computer. In addition, the Owner shall be able to upload the most current versions of all energy management control programs, Direct Digital Control programs, database parameters, and all other data and programs in the memory of each BC to the operator workstation via the local area network, or via the telephone line dial-up modem where applicable, or to the laptop PC via the local RS-232C port.

19. BC Failure:

a. Controller LAN Data Transmission Failure: BC shall continue to operate in stand-alone mode. BC shall store loss of communication alarm along with the time of the event. All control functions shall continue with the global values programmable to either last value or a specified value.
b. BC Hardware Failure: BC shall cease operation and terminate communication with other devices. All outputs shall go to their specified fail position.

20. Each BC shall be equipped with firmware resident or software self-diagnostics for sensors and be capable of assessing an open or shorted sensor circuit and taking an appropriate control action (close valve, damper, etc.).
21. BCs may include LAN communications interface functions for controlling s\Secondary controlling LANs Refer to Section 230923 - EMCS System Communications Devices for requirements if this function is packaged with the BC.
22. BCs shall be mounted on equipment, in packaged equipment enclosures, or locking wall mounted in a NEMA 1 enclosure, as specified elsewhere.

B. BACnet Building Controller Requirements:

1. The BC(s) shall support all BIBBs defined in the BACnet Building Controller (B-BC) device profile as defined in the BACnet standard.
2. Each BC shall be connected to the BACnet Primary Controller LAN communicating to/from other BCs.

## 2.4 ADVANCED APPLICATION SPECIFIC CONTROLLER (AAC) AND APPLICATION SPECIFIC CONTROLLER (ASC)

A. General Requirements:

1. AACs and ASCs shall be connected to the Primary or Secondary Controller LAN.
2. AACs and ASCs shall provide intelligent, standalone control of HVAC equipment. Each unit shall have its own internal RAM, non-volatile memory and will continue to operate all local control functions in the event of a loss of communications on the Secondary LAN. Refer to standalone requirements by application specified in Part 3 of this section. In addition, it shall be able to share information with every other BC and AAC /ASC on the entire network.
3. Each AAC and ASC shall include self-test diagnostics that allow the AAC /ASC to automatically relay to the BC, LAN Interface Device or workstation, any malfunctions or abnormal conditions within the AAC /ASC or alarm conditions of inputs that exceed desired parameters as determined by programming input.
4. AACs and ASCs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.
5. Each AAC and ASC must be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, voltage transient and lightning protection devices.
6. All point data; algorithms and application software within an AAC /ASC shall be modifiable from Operator Interfaces.
7. Memory:

    a. Memory for data trending is not required for AACs and ASCs. If not provided in controller, memory for trend data shall reside in BCs connected to the same Network.
    b. Provide sufficient internal memory for the specified sequences of operation. For AACs, there shall be a minimum of approximately 25% of available memory free for future programming changes. Provide additional AACs or a BC if needed to comply with this requirement.

8. AAC Input-Output Processing. Same as BCs (paragraph 2.3A.13) except A/D converters may be 10 bit.
9. ASC Input-Output Processing:

    a. Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 0.5 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output. Each DO shall be discrete outputs from the ASC's board (multiplexing to a separate manufacturer's board is unacceptable). Provide suppression to limit transients to acceptable levels.
    b. Analog Inputs (AI): AI shall be 0-5 Vdc or direct thermistor connection. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the ASC's board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 10 bits.
    c. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the ASC and shall be isolated from the main board. Software multiplexing of an AI and

resistors may only be done in non-critical applications and only with prior approval of the Owner.

d. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.

e. Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog is not acceptable. D/A converters shall have a minimum resolution of 8 bits.

f. Analog Output Pneumatic (AOP), 0-20 psi: Pneumatic outputs via an I/ or V/P transducer. Multiplexed digital to pneumatic transducers are acceptable provided they are supplied as a standard product and part of the ASC and provide individual feedback. Multiplexed pneumatic outputs of a separate manufacturer are unacceptable.

B. BACnet AAC(s) and ASC(s) Requirements:

1. The AAC(s) and ASC(s) shall support all BIBBs defined in the BACnet Building Controller (B-AAC and B-ASC) device profile as defined in the BACnet standard.
2. AAC(s) and ASC(s) shall communicate over the BACnet Primary Controller LAN or the Secondary LAN.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details shown on drawings.

### 3.2 HARDWARE APPLICATION REQUIREMENTS

A. General: The functional intent of this specification is to allow cost effective application of manufacturers standard products while maintain the integrity and reliability of the control functions. A BC as specified above is generally fully featured and customizable whereas the AAC/ASC refers to a more cost-effective unit designed for lower-end applications. Specific requirements indicated below are required for the respective application. Manufacturer may apply the most cost-effective unit that meets the requirement of that application.

B. Software Capability: Regardless of application category listed below, each Control Unit shall be capable of performing the specified sequence of operation for the associated equipment. All physical point data and calculated values required to accomplish the sequence of operation shall originate within the associated CU with only the exceptions enumerated below. Refer to requirements herein above for physical limitations of standalone functionality. Listed below are functional point data and calculated values that shall be allowed to be obtained from or stored by other CUs via LAN.

1. Remote pressure sensors. To meet the requirements of this section, differential pressure sensors controlling fans and pumps shall either be home-run wired back to the CU controlling the fan/pump VFD; or install another DP sensor (not shown in points list) near the fan/pump and connected to the CU controlling the pump, connect remote sensors to remote CUs, and use cascading control loops (remote sensor loops reset setpoint for local sensor loop via the network, and local sensor loop controls the pump/fan).

C. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.

D. Application Category 0 (Distributed Monitoring).

1. Applications in this category include the following:

a. Monitoring of variables that are not used in a control loop, sequence logic, or safety. Examples include status of sump pumps or associated float switches, temperatures in monitored electrical rooms.

2. Applicable Controllers: Available points on conveniently located BCs, AACs, and ASCs may be used in these applications.
3. Contractor shall verify and document that the network bandwidth is acceptable to accept specified trends of monitored points.

E. Application Category 1 (Application Specific Controller).

1. Applications in this category include the following:

a. Fan Coil Units.
b. Terminal Units (e.g. VAV and Constant Volume Boxes).
c. Miscellaneous heaters.
d. Constant speed exhaust fans and pumps.
e. Unitary single zone units with self-contained controls (Package Terminal AC Units, Package Terminal Heat Pumps, Split-System AC Units, Split-System Heat Pumps, Water-Source Heat Pumps, Computer Room AC units).

2. Applicable Controllers: ASCs may be used in these applications.
3. Standalone Capability: Provide capability to execute control functions for the application for a given setpoint or mode, which shall generally be occupied mode control. Only the following data (as applicable) may be acquired from other controllers via LANs. In the event of a loss of communications with any other controller, or any fault in any system hardware that interrupts the acquisition of any of these values, the ASC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

| Physical/Virtual Point | Default Value |
|---|---|
| Time of day | Occupied |
| Scheduling Mode | Occupied |
| Morning Warm-Up | Off (cold discharge air) |
| Load Shed | Off (no shedding) |
| Trend Data | N/A |

4. Mounting:

    a. ASCs that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure and shall be rated for plenum use if ceiling attic is used as a return air plenum.
    b. ASCs that control equipment mounted in a mechanical room may either be mounted in/on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.
    c. ASCs that control equipment mounted outside or in occupied spaces shall either be located in the unit or in a proximate mechanical/utility space.

5. Mounting: LAN Restrictions: Limit the number of nodes on the network to the maximum recommended by the manufacturer.
6. Trending Restrictions: BCs connected to same Network shall be capable of storing trend data for points associated with ASCs and must still meet the requirement of paragraph 2.3A.11, or special purpose trend storage devices meeting the requirement of paragraph 2.3A.11 for ASC points must be added for this purpose.

F. Application Category 2 (Advanced Application Controller).

1. Applications in this category include the following:

    a. Unitary VAV AC Unit with self-contained controls.
    b. Single Zone Air Handling Units.
    c. Constant or variable speed pump station.
    d. DHW Converter control/monitoring.

2. Applicable Controllers:

    a. BCs may be used in these applications.
    b. AACs may be used in these applications provided the AAC meets all requirements specified below and all control functions and physical I/O associated with a given unit resides in one AAC.

3. Standalone Capability: Only the following data (as applicable) may be acquired from other AACs or BCs via LANs. In the event of a loss of communications with any other AACs, or any fault in any system hardware that interrupts the acquisition of any of these values, the AAC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

| Physical/Virtual Point | Default Delay Time | Default Value |
|---|---|---|
| Outside Air Temperature | 3 minutes | 80˚F |
| Trend Data | | N/A |

4. Trending Restrictions for AACs: BCs connected to same Network shall be capable of storing trend data for points associated with AACs that do not have on-board trend storage capability and must still meet the requirement of paragraph 2.3A.11, or special purpose trend storage devices meeting the requirement of paragraph 2.3A.11 for AAC points must be added for this purpose.
5. Mounting:

    a. AACs/BCs that control equipment located above accessible ceilings shall be mounted in a NEMA 1, locking enclosure, and shall be rated for plenum use if ceiling attic is used as a return air plenum.
    b. AACs/BCs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure (responsibility for physical fit remains with the Contractor) or in a proximate mechanical/utility room in which case it shall be enclosed in a NEMA 1, locking enclosure.

G. Application Category 3 (Building Controller)

1. Applications in this category include the following:

    a. VAV Air Handlers.
    b. Central Cooling Plant.
    c. Central Heating Plant.

2. Applicable Controllers: BCs shall be used in these applications.
3. Mounting: See 3.2F.5

## 3.3 CONTROL POWER

A. Refer to Section 230900 for power to control panels.

END OF SECTION

SECTION 23 09 23 – EMCS COMMUNICATION DEVICES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 WORK INCLUDED

A. Provide and install the following:

1. LAN Interface Devices/Routers
2. BACnet Gateways

B. Refer to Section 230900 for general requirements.

### 1.3 RELATED WORK AND REQUIREMENTS

A. Other EMCS Sections:

1. Section 230900 Energy Management and Control System (EMCS) - General
2. Section 230913 EMCS Basic Materials and Devices
3. Section 230916 EMCS Operator Interfaces
4. Section 230919 EMCS Field Panels
5. Section 230933 EMCS Commissioning

## PART 2 - PRODUCTS

### 2.1 CONTROLLER LOCAL AREA NETWORK INTERFACE DEVICES (LANID)

A. The Controller LANID shall be a microprocessor-based communications device which acts as a gateway/router between the Primary LAN, Secondary LAN, an operator interface, modem to support remote operator interface, or printer. These may be provided within a BC or as a separate device.

B. The LANID shall perform information translation between the Primary LAN and the Secondary LAN, supervise communications on a polling secondary LAN, and shall be applicable to systems in which the same functionality is not provided in the BC. In systems where the LANID is a separate device, it shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply as specified for a BC in Section 230919. Each LANID shall be mounted in a lockable enclosure.

C. Each LANID shall support interrogation, full control, and all utilities associated with all BCs on the Primary LAN, all AACs and ASCs connected to all secondary LANs under the Primary Controller LAN, and all points connected to those PCUs and SCUs.

D. Upon loss of power to a LANID, the battery shall provide for minimum 100-hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.

E. The LANID shall be transparent to control functions and shall not be required to control information routing on the Primary LAN.

## 2.2 SUPERVISORY LAN ROUTERS

A. The Supervisory Router shall be a microprocessor-based communications device that acts as a router between the Supervisory LAN CSSs or OWS and the Primary LAN.

B. The Supervisory Router shall not perform information translation. Both Primary LAN and the Supervisory LAN shall use BACnet.

C. The Supervisory Router shall contain its own microprocessor, RAM, communication ports, and power supply. Each Supervisory Router shall be mounted in a lockable enclosure.

D. The Supervisory Router shall allow centralized overall system supervision, operator interface, management report generation, alarm annunciation, acquisition of trend data, and communication with control units. It shall allow system operators to perform the following functions from the CSS, OWSs, and POTs:

1. Configure systems.
2. Monitor and supervise control of all points.
3. Change control setpoints.
4. Override input values.
5. Override output values.
6. Enter programmed start/stop time schedules.
7. View and acknowledge alarms and messages.
8. Receive, store and display trend logs and management reports.
9. Upload/Download programs, database, etc. as specified.

E. Upon loss of power to the Supervisory Router, the battery shall provide for minimum 100-hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.

F. The Supervisory Router shall be transparent to control functions and shall not be required to control information routing on the Primary LAN.

## 2.3 BACnet BROADCAST MESSAGE ROUTING

A. To allow BACnet broadcast messages to be relayed from remote nodes communicating via the internet and connecting to the Supervisory Router through IP protocol, a BACnet/IP Broadcast Management Device

(BBMD) shall be provided which conforms to the Annex J definition of the BACnet standard for two-hop distribution. Multicast messaging or one-hop distribution requiring configuration of IP routers which are not part of the EMCS vendor's cope in not acceptable.

## 2.4 BACNET GATEWAYS

A. Gateways shall be provided to link non-BACnet control products to the BACnet inter-network. All of the functionality described in this section is to be provided by using the BACnet capabilities. Each Gateway shall have the ability to expand the number of BACnet objects of each type supported by 20% to accommodate future system changes.

B. Each Gateway shall provide values for all points on the non-BACnet side of the Gateway to BACnet devices as if the values were originating from BACnet objects. The Gateway shall also provide a way for BACnet devices to modify (write) all points specified by the AOC using standard BACnet services. All points are required to be writable for each site.

C. The Gateway shall implement BACnet schedule objects and permit both read and write access to the schedules from the workstation.

D. Each Gateway shall provide a way to collect and archive or trend (time, value) data pairs.

E. Each Gateway and any devices that the Gateway represents which have time-of-day information shall respond to workstation requests to synchronize the date and time. Each Gateway and any devices that the Gateway represents shall support dynamic device binding and dynamic object binding.

F. All points in the system shall be made network visible through the use of standard BACnet objects or through proprietary BACnet extensions that the workstation also supports. All points shall be writable using standard BACnet services.

G. All devices have a Device Object instance number that is unique throughout the entire inter-network. All BACnet devices shall be configured with a Device Object instance number that is based on the format specified (shown in decimal notation). This includes all physical devices as well as any logical BACnet devices that are physically represented by Gateways.

H. All BACnet Interoperability Building Blocks (BIBBs) are required to be supported for each native BACnet device or Gateway. The Gateway shall support all BIBBs defined in the BACnet Gateway's device profile as defined in the BACnet standard.

I. Upon loss of power to a Gateway, the battery shall provide for minimum 1000-hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.

J. UL 916 CE FCC part 15 Subpart B – Class A with surge and transient protection circuitry for power and communications.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details shown on drawings.

B. Contractor shall provide all interface devices and software to provide an integrated system.

C. See Control Power in Section 230900 for device power options and requirements.

### 3.2 LANID AND LAN ROUTERS

A. Provide as required. See System Architecture in Section 230900.

B. At each building, connect Supervisory LAN to Owner’s IT/LAN or dedicated EMCS network (whichever is applicable).

C. Connect networks to both sides of device.

D. Thoroughly test to ensure proper operation.

E. Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted. The system shall automatically monitor the operation of all network devices and annunciate any device that goes off-line because it is failing to communicate.

### 3.3 GATEWAYS

A. General.

1. Wire to networks on both sides of device.
2. Map across all monitoring and control points listed on drawings.
3. Thoroughly test each point to ensure that mapping is accurate.
4. Initiate trends of points as indicated on drawings.

END OF SECTION

SECTION 23 09 26 – EMCS SOFTWARE AND PROGRAMMING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 WORK INCLUDED

A. Provide and install the following:

1. System Software
2. Programming Software
3. Graphical User Interface Software

B. Refer to Section 230900 for general requirements.

### 1.3 RELATED WORK AND REQUIREMENTS

A. Other EMCS Sections:

1. Section 230900 Energy Management and Control System (EMCS) - General
2. Section 230913 EMCS Basic Materials and Devices
3. Section 230916 EMCS Operator Interfaces
4. Section 230919 EMCS Field Panels
5. Section 230923 EMCS Communication Devices
6. Section 230933 EMCS Commissioning

### 1.4 GENERAL

A. System software shall be based on server/thin-client architecture, designed around the open standards of web technology. Servers shall be accessed using a web browser over the control system Supervisory LAN, the Owner intranet, and remotely over the Internet (through the Owner IT WAN/LAN).

B. The intent of the thin-client architecture is to provide operators complete access to the EMCS via a web browser GUI. No special software other than a web browser (including active-x components or fat java clients) shall be required to be installed on OIs used to access the EMCS graphics, point displays, trends, and trend configuration. Additional software other than a browser may be used to configure or modify the EMCS and programming.

C. The Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified.

The Contractor shall include all software and programming not specifically itemized in these specifications that is necessary to implement, maintain, operate, and diagnose the system in compliance with these specifications.

D. Software Components: All software components of the BAS system software shall be installed and completed in accordance with the specification. BAS system components shall include:

1. Server Software, Database and Web Browser Graphical User Interface
2. System Configuration Utilities for future modifications to the system.
3. Graphical Programming.
4. Direct digital control software.
5. Application Software.

E. Database Open Connectivity: The BAS server database shall be Java DataBase Connectivity (JDBC) compatible, allowing real time access of data via XML/SOAP.

## 1.5 LICENSING

A. Include licensing and hardware keys for all software packages at all workstations (OWSs and POTs) and servers.

B. Within the limitations of the servers, any number of users shall have web access to the CSS at any given time.

C. All operator interface programming environment, networking, database management and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the Owner.

D. All operator software, including that for programming and configuration, shall be available on all workstations. Hardware and software keys to provide all rights shall be installed on all workstations.

# PART 2 - PRODUCTS

## 2.1 CONTROLLER SOFTWARE

A. BC Software Residency: Each BC shall be capable of control and monitoring of all points physically connected to it. All software including the following shall reside and execute at the BC:

1. Real-Time Operating System software.
2. Real-Time Clock/Calendar and network time synchronization.
3. BC diagnostic software.
4. LAN Communication software/firmware.
5. Direct Digital Control software.
6. Alarm Processing and Buffering software.

7. Energy Management software.
8. Data Trending, Reporting, and Buffering software.
9. I/O (physical and virtual) database.
10. Remote Communication software.

B. AAC/ASC Software Residency: Each AAC/ASC shall be capable of control and monitoring of all points physically connected to it. As a minimum, software including the following shall reside and execute at the AAC/ASC. Other software to support other required functions of the AAC/ASC may reside at the BC or LAN interface device (specified in Section 230923) with the restrictions/exceptions per application provided in Section 230919:

1. Real-Time Operating System software.
2. AAC/ASC diagnostic software.
3. LAN Communication software.
4. Control software applicable to the unit it serves that will support a single mode of operation.
5. I/O (physical and virtual) database to support one mode of operation.

C. Stand Alone Capability: BC shall continue to perform all functions independent of a failure in other BC/AAC/ASC or other communication links to other BCs/AACs/ASCs. Trends and runtime totalization shall be retained in memory. Runtime totalization shall be available on all digital input points that monitor electric motor status. Refer also to Section 230919 for other aspects of stand-alone functionality.

D. Operating System: Controllers shall include a real-time operating system resident in ROM or EEPROM. This software shall execute independently from any other devices in the system. It shall support all specified functions. It shall provide a command prioritization scheme to allow functional override of control functions. Refer also to Section 230919 for other aspects of the controller’s operating system.

E. Network Communications: Each controller shall include software/firmware that supports the networking of CUs on a common communications trunk that forms the respective LAN. Network support shall include the following:

1. Building Controller/Primary LAN shall be a high-speed network designed and optimized for control system communication. If a Primary LAN communications trunk is severed, BCs shall reconfigure into two separate LANs and continue operations without interruption or Operator intervention.
2. Controller communication software shall include error detection, correction, and re-transmission to ensure data integrity.
3. Operator/System communication software shall facilitate communications between other BCs, all subordinate AACs/ASCs, Gateways and LAN Interface Devices or Operator Workstations. Software shall allow point interrogation, adjustment, addition/deletion, and programming while the controller is online and functioning without disruption to unaffected points. The software architecture shall allow networked controllers to share

selected physical and virtual point information throughout the entire system.

F. Diagnostic Software: Controller software shall include diagnostic software that checks memory and communications and reports any malfunctions.

G. Alarm/Messaging Software: Controller software shall support alarm/message processing and buffering software as specified below.

H. Application Programs: CUs shall support and execute application programs specified.

I. Updating/Storing Application Data: Site-specific programming residing in volatile memory shall be up-loadable/downloadable from an OWS or CSS using BACnet services connected locally, to the Primary LAN, to the Local Supervisory LAN and remotely via modem and telephone lines as applicable but all must be available. Initiation of an upload or download shall include all of the following methods; Manually, Scheduled and Automatically upon detection of a loss or change.

J. Power Loss and Restart: System software shall provide for orderly shutdown upon loss of power. Volatile memory shall be retained. Outputs shall go to programmed fail position, which as a default shall be set to their position in unoccupied mode. Equipment restart shall be automatic upon power restoration and shall include a user definable time delay on each piece of equipment to stagger the restart. Loss of power shall be alarmed at operator interface indicating date and time.

K. Time Synchronization: Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device, devices on a single network, or all devices simultaneously. Automatic time synchronization shall be provided using BACnet services.

L. Anti-dithering. In order to improve the life expectancy of modulating electronic actuators, software shall limit the number of re-positions. This can be accomplished by providing anti-dithering software, a small deadband for fully proportioning actuators, and by ensuring that floating actuators do not receive control pulses of excessively short duration.

## 2.2 GRAPHICAL USER INTERFACE SOFTWARE

A. A web browser installed on each OWS, POT, and server (see Section 230916) shall serve as the graphical user interface to the EMCS. Communication between the web server GUI and EMCS server shall be encrypted using 128-bit encryption technology within Secure Socket Layers. Communication protocol shall be Hyper-Text Transfer Protocol.

B. The 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 all features specified in this section.

C. The GUI shall (as a minimum) provide a Navigation Pane for navigation, and a Action Pane 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.

D. Login. Upon 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. See Security Access below.

E. Navigation Pane

1. The Navigation Pane shall comprise a Navigation Tree which defines a geographic hierarchy of the EMCS system. Navigation through the GUI shall be accomplished by clicking on appropriate level of a navigation tree (consisting of expandable and collapsible tree control like Microsoft's Explorer program), and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane defined below shall be displayed simultaneously, enabling the operator to select a specific system or equipment, and view the corresponding graphic. The navigation tree shall as a minimum provide the following views:

    a. Geographic View shall display a logical geographic hierarchy of the system including: Cities, sites, buildings, building systems, floors, equipment and BACnet objects.
    b. Network View shall display the hierarchy of the actual BACnet IP Intranet network. This can include: Systems, Site, Networks, Routers, Half-Routers, Devices, Equipment and all the BACnet Objects in a device.
    c. Groups View shall display Scheduled Groups and custom reports.
    d. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).

2. Alternative interface structures will also be accepted if they provide similar ease of navigation through the system hierarchy.

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 animated gifs or other 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 as frequently as 6 updates per minute.

2. Properties: Shall include graphic controls and text for the following: Locking or overriding BACnet objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress a 'accept/cancel' button.
3. Schedules: Shall be used to create, modify/edit and view schedules based on the systems geographical hierarchy and in compliance with paragraph 2.2H.
4. Events: Shall be used to view alarm event information geographically (using the navigation tree), acknowledge events, sort events 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 a 'live' graphic programs of the control algorithm for the mechanical/electrical system selected in the navigation tree.

G. Graphics:

1. The GUI shall make extensive use of color in the graphic pane to communicate information related to setpoints and comfort. Animated graphics and active setpoint graphic controls shall be used to enhance usability.
2. Graphics tools used to create Web Browser graphics shall be non-proprietary and provided and installed on each OWS.
3. Graphical display shall be 1280 x 1024 pixels or denser, 256 color minimum.
4. Links:

    a. Graphics shall include hyperlinks which when selected (i.e. clicked on with mouse) launch applications, initiate other graphics etc.
    b. Screen Penetration: Links shall be provided to allow user to navigate graphics logically without having to navigate back to the home graphic. See additional discussion in Paragraph 3.5.
    c. Informational Links:

        1) On each MEP system and subsystem graphic, provide links to display in a new window the information listed below.

            a) English-language control sequence associated with the system. See drawings.
            b) O&M and submittal information for the devices on the graphic. See Section 230900 and Section 230010.

        2) The display shall identify the target of the link by file name/address.
        3) Information shall be displayed in electronic format that is text searchable.
        4) Window shall include software tools so that text, model numbers, or point names may be found. Source documents shall be read-only (not be editable) with this software, however.

5. Point Override Feature:

a. Every real output or virtual point displayed on a graphic shall be capable of being overridden by the user (subject to security level access) by mouse point-and-click from the graphic without having to open another program or view.
b. When the point is selected to be commanded:

    1) Dialog box opens to allow user to override the point (place in "operator mode") or release the point ("automatic mode"). Operator mode will override automatic control of the point from normal control programs.
    2) Dialog box shall have buttons (for digital points) or a text box and/or slide bar (for analog points) to allow user to set the point's value when in operator mode. These are grayed out when in automatic mode.
    3) When dialog box is closed, mode and value are sent to controller.
    4) Graphic is updated upon next upload scan of the actual point value.

c. A list of points that are currently in an operator mode shall be available through menu selection.

6. Point override status (if a digital point is overridden by the supervised manual override per Section 230919 or if a point is in operator mode per 2.2G.5) shall be clearly displayed for each point, e.g. by changing color or flag.
7. The color of symbols representing equipment shall change color or become animated based on status of binary point to graphically represent on/off status.
8. On floor plan displays of spaces, temperature shall be graphically displayed by coloring the zone area in accordance with or similar to the following:

    a. Red: space temperature above cooling setpoint by 2°F (adj.) or more. This condition can be programmed to generate an alarm.
    b. Yellow: space temperature between cooling setpoint and 2°F (adj.) above setpoint.
    c. Green: space temperature between cooling and heating setpoints and space is in occupied mode.
    d. Gray: space temperature between cooling and heating setpoints and space is in unoccupied mode.
    e. Light blue: space temperature between heating setpoint and 2°F (adj.) below setpoint.
    f. Dark blue: space temperature below heating setpoint by 2°F (adj.) or more. This condition can be programmed to generate an alarm.

9. On floor plan displays of spaces, lighting shall be graphically displayed by coloring the lighting zone area in accordance with or similar to the following:

    a. Yellow: lights on by timed override.
    b. Red: lights on by manual override in lighting panel.
    c. Green: lights on by schedule.

d. Gray: lights off.

10. Floor plans shall include final room names and room numbers as confirmed by the Owner. Room names and room numbers included in Construction Documents are not necessarily the final room names and room numbers. Division 23C Contractor shall be responsible for obtaining and confirming the final room names and room numbers from Owner. Changes to floor plan graphics resulting from wrong room names and room numbers shall be made at no additional charge to the Owner.

H. Graphics Development Package:

1. Graphic development and generation software shall be provided to allow the user to add, modify, or delete system graphic displays.
2. Provide capability to store graphic symbols in a symbol directory and incorporate these symbols into graphics.
3. Provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers, etc.), mechanical system components (e.g., pumps, chillers, cooling towers, boilers, etc.), complete mechanical subsystems (e.g. VAV reheat zone, etc.) and electrical symbols.
4. The Graphic Development Package shall use a mouse or similar pointing device to allow the user to perform the following:

    a. Define symbols.
    b. Position items on graphic screens.
    c. Attach physical or virtual points to a graphic.
    d. Define background screens.
    e. Define connecting lines and curves.
    f. Locate, orient and size descriptive text.
    g. Define and display colors for all elements.
    h. Establish correlation between symbols or text and associated system points or other displays.
    i. Create hot spots or link triggers to other graphic displays or other functions in the software.

5. A single graphic file shall be used for common control applications (e.g. VAV box) so that any updates to the graphic may be done once and automatically applied to all applications. Displayed points shall be automatically populated based on "wild card" entry of point name in graphic definition.

I. Time and Schedules:

1. Provide a time master that is installed and configured to synchronize the clocks of all BACnet devices supporting time synchronization. Synchronization shall be done using Coordinated Universal Time. All trend sample times shall be able to be synchronized. The frequency of time synchronization message transmission shall be selectable by the operator.
2. System shall automatically change time/date for Daylight Savings Time and leap years.
3. An operator (with password access) shall be able to define a Normal, 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 "isolation" 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 Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the 'Independence Day' Holiday.

4. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
5. Schedules shall comply with the BACnet standard, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:

    a. Types of schedule 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).
    e. Wildcard (example, allow combinations like second Tuesday of every month).

6. 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.
7. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule 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'.
8. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (example: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
9. 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.
10. Schedule Distribution: For reliability and performance, instead of maintaining a single schedule in a field device that writes over the network to notify other devices when a scheduled event occurs, field devices will only keep their part of the schedule locally. The EMCS server software shall determine which nodes a hierarchical schedule applies to and will create/modify the necessary schedule objects in each field device as necessary.

J. Events and Alarms:

1. Events and alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an 'Events' view.
2. Events View: Each event shall display an Event Category (using a different icon for each event category), date/time of occurrence, current status, and event report. An operator shall 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.
3. Event Categories (Alarm Levels): The operator shall be able to create, edit or delete event categories (alarm level). An icon shall be associated with each Event category, enabling the operator to easily sort through multiple events displayed. Alarm levels shall be initially configured by the Contractor as follows:

    a. Level 1: Critical/life safety.
    b. Level 2: Significant equipment failure.
    c. Level 3: Non-critical equipment failure/operation.
    d. Level 4: Energy conservation monitor.
    e. Level 5: Maintenance indication, notification.

4. BACnet Event Templates: BACnet Event template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of event, acknowledgement requirements, high/low limit and out of range information.
5. Event Areas (Actions): Each Event Categories (Alarm Level) shall be configured to specific Event Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance events on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Event Areas in the Graphic Pane. For initial setup, contractor shall configure events as follows:

    a. Levels 1 and 2: Print to alarm printer and call/text two engineers.
    b. Level 3: Print to alarm printer and email engineer responsible for building/system.
    c. Levels 4 and 5: Email engineer responsible for building/system

6. Event Reporting Actions: Event Reporting Actions specified shall be automatically launched (under certain conditions) after an event is received by the EMCS server software. Operators shall be able to define these Reporting Actions using the Navigation Tree and Graphic Pane through the GUI. Reporting Actions shall be as follows:

    a. GUI dialog box: Provide visual and optional audible alarm indication. The alarm dialog box shall always become the top dialog box upon receipt of an alarm irrespective of the foreground application.

b. Print: Alarm/Event information shall be printed to the any network accessible printer.
c. Email: Alarm/Event information shall be via email to a POP3 address on the Owner's intranet or through this intranet to the internet.
d. Call/Text: Alarm/Event information shall be sent via alphanumeric call/text via email to internet alphanumeric call/text services.
e. 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).
f. Write Property: The write property reporting action updates a property value in a hardware module.
g. Run External Program: The Run External Program reporting action launches specified program in response to an event.

7. Event 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.
8. Event Configuration: Operators shall be able to define the type of events generated per BACnet object. A 'network' view of the Navigation Tree shall expose all BACnet objects and their respective Event Configuration. Configuration shall include assignment of event, alarm, type of Acknowledgement and notification for return to normal or fault status.
9. Event Summary Counter: The view of events in the Graphic Pane shall provide a numeric counter, indicating how many events are active (in alarm), require acknowledgement, and total number of events in the EMCS Server database.
10. Event Auto-Deletion: Events that are acknowledged and closed, shall be auto-deleted from the database, and archived to a text file after an operator defined period. The file shall be stored in file on the CSS with no limit to quantity or age of alarms, other than limitations of hard disk. The file can be archived to tape and deleted by operator to clear disk space.
11. Data Format. The system shall allow for external systems to access the event instance data. Event data shall be stored and queried in the database in a relational manner. At a minimum, the fields to be stored in the database are:

    a. Event Source.
    b. Event Generation Tie.
    c. Acknowledge Required Flag.
    d. Delivery Priority.
    e. BACnet Event Type.
    f. Event Message Text.
    g. BACnet Event Parameter.
    h. Classification of Event.
    i. Event Acknowledgement Time.
    j. Return to Normal Time.
    k. Operator Comments.
    l. Who Acknowledged the Event.

12. Event Simulator: The GUI user shall provide an Event Simulator to test assigned Reporting Actions. The operator shall have the option of using current time or scheduling a specific time to generate the Event. Utilizing the Navigation Tree and drop-down menus in the Graphic Pane, the operator shall be able to select the Event Type, Status, Notification, Priority, Message, and whether acknowledgement is required.

K. Trends:

1. Trending and trend analysis capabilities are considered critical to system performance. The system shall be designed to upload and record large amounts of point data without causing network bottlenecks or affecting proper system operation. A separate server (Historical Trend Server) shall be provided (see Section 230916) in order to reduce network traffic to and disk activity on the CSS. The system as a whole shall be designed to comply with the trending capability test defined in Section 230933.
2. Every point, both real and virtual, shall be available for data trending.
3. Trending software shall be capable of recording point values and time on a user specified regular time step, and on a change-of-value (COV) basis (data is recorded when point changes by a specified amount for analog points or by changes of state for binary points), at the user's option. Sampling intervals shall be as small as one second. Each trended point shall have the ability to be trended at a different sampling interval.
4. Trend data shall be sampled and stored in control panel memory (see Section 230919). If historical trending is enabled for the BACnet object, trend data shall be uploaded from control panels to the THS on a user-defined interval, manual command, or automatically when the trend buffer becomes full. There shall be no limit to the amount of trend data stored at the THS other than hard disk limitations.
5. Trends shall conform to the BACnet Trend Log Object specification. Trends shall both be displayed and user configurable through the GUI. Trend logs may comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
6. Viewing Trends:

    a. Trend data shall be displayed graphically by the GUI. This shall be a capability internal to the workstation software and not a capability resulting from download of trend data on a third-party spreadsheet program unless such transfer is automatic and transparent to the operation and the third-party software is included with the workstation software package.
    b. The software shall be capable of dynamically graphing the trend logged object data by creating two-axis (x, y) graphs that simultaneously display values relative to time for at least eight objects in different colors, even if objects have been trended at different time intervals. Where trended values are COV, software shall automatically fill the trend samples between COV entries. A graph legend shall identify each variable plotted.

c. Multiple scales shall be possible, one for each object, with range set automatically by the software but capable of being manually adjusted by the operator.
d. Trend format, displayed points, etc. shall be capable of being saved as a template for future trend displays.
e. Trends shall be able to dynamically update at operator-defined intervals, including on a 1 second interval for loop tuning.
f. 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.
g. It shall be possible to pick (or float mouse over) any sample on a trend and have the numerical value displayed.
h. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard Windows keystrokes.

7. Trend Data Storage

a. The database shall allow applications to access the data while the database is running. The database shall not require shutting down in order to provide read-write access to the data. Data shall be able to be read from the database without interrupting the continuous storage of trend data being carried by the EMCS.
b. Provide a single licensed copy of Microsoft SQL Server and install on the OWS.
c. Data shall be accessible to off-site SQL compliant database software through the Owner's intranet and/or internet.

L. Security Access:

1. Security access from the GUI to EMCS servers shall require a Login Name and Password.
2. Access to different areas of the EMCS shall be defined in terms of roles and geographic area of responsibility as specified.
3. Roles shall reflect the actual roles of different types of operators. Roles shall be defined in terms of View, Edit and Function Privileges.

a. View Privileges: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
b. Edit Privileges: Setpoint, Tuning and Logic, Manual Override, and Point Assignment Parameters.
c. Function Privileges: Alarm/Event Acknowledgement, Control Module Configuration, Memory Download, and Upload, Schedules, Schedule Groups, Manual Commands, Print, and Alarm/Event Maintenance.

4. Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. 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.

5. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected for an adjustable period of time. This auto logoff time shall be set individually per operator.
6. Provide an audit trail of actions taken by any user, including the username and time. Store in secure file in database format on the CSS. Provide software to view and print audit trail.

M. Report Software:

1. Provide software to create standard and custom reports of point status, alarms, etc. Report format, displayed points, time period (daily, weekly, monthly, or annual), etc. shall be capable of being saved as a template for future reports. Reports shall be time and date stamped and shall contain a report title editable by the user.
2. Reports shall be capable of being sent to a printer or export to Word or ASCII format to a file and shall be capable of being generated automatically based on date and time of day.
3. Standard reports. Prepare the following standard reports for each building and the Owner as a whole, accessible automatically without requiring definition by user:

    a. Tenant after-hour usage. System must be capable of monitoring tenant override requests and generating a monthly report showing the daily total time in hours that each tenant has requested after-hours HVAC services.
    b. Monthly and annual energy usage and cost.
    c. Alarm events and status.
    d. Points in "hand" (operator override) via Workstation command (including name of operator who made the command) or via supervised HOA switch at output, including date and time.
    e. Position reset: Where zones or system valve or damper positions are used to reset supply air/water temperature or differential pressure setpoints:

        1) EMCS shall record the following on an hourly basis: the descriptors of the zones/systems that have dampers/valves at the highest cooling/heating position, i.e. the control point that is being used in the reset loop. The information shall be accumulated in a report format for periodic printing upon operator command.
        2) Configure a tabular report using real-time or trend data with the following column headings: ZONE [SYSTEM] DESCRIPTION, VALVE [DAMPER] POSITION (0 to 100%), LOOP OUTPUT %, [CHWST, CHWDP, SAT, etc.] SETPOINT. At the top of the table, list building number, floor, or area description if applicable, air handling unit or HW/CHW pump system designation.

## 2.3 CONTROL PROGRAMMING SOFTWARE

A. Points:

1. Provide templates customized for point type, to support input of individual point information using standard BACnet Objects, including long-name field.
2. All real and virtual points shall be accessible to any control panel for use in any control sequences regardless of physical location.

B. Programming Language:

1. All controllers must be fully user-programmable using a single programming language for all control devices. Use of "canned" (preprogrammed, burned-in) software is not acceptable.
2. The control programming language must allow virtually any control sequences to be written. Software shall be capable of the sequences specified on drawings without exception.
3. All custom programs shall be modifiable from Operator Workstations without having to "burn chips". Software shall allow the user to modify and input control sequence software and to download to panels via the control network.
4. The programming language shall support floating point arithmetic using the following operators and functions: +, -, /, x, square root, and x-to-the-y-power, natural log, log, trigonometric functions (sine, cosine, etc.), absolute value, minimum/maximum value from a list of values, and psychrometric parameters (wetbulb, dewpoint, and enthalpy) from temperature and relative humidity.
5. The programming language shall have predefined variables that represent time of day, day of the week, month of the year, and the date. Other predefined variables shall provide elapsed time in seconds, minutes, hours, and days. These elapsed time variables shall be able to be reset by the language so that interval timing functions can stopped and started within a program.
6. The system must be capable of supporting software ("virtual") points to be used in control sequences and monitored just as if they were real digital or analog points.
7. Control programming shall employ the BACnet protocols for Standard Command Priorities.
8. A PID (proportional-integral-derivative) algorithm with adjustable gains and anti-windup shall be included as an integral part (subroutine) of the programming language, not requiring special programming or hardware.
9. The programming language shall be graphical. BASIC-like or other line- or block-type programming languages are not acceptable. With the graphical programming language, a sequence of operations shall be created by drag-and-drop assembling on screen of graphic blocks that represent each of the commands or functions necessary to complete a control sequence. Blocks represent common logical control devices such as relays, switches, high signal selectors, PID loops, optimum start, etc. Blocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of graphic blocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
10. The graphic programming software shall support a 'live' mode, where all input/output data, calculated data, and setpoints shall

be displayed in a 'live' real-time mode. For each piece of HVAC equipment, the entire graphic program shall be displayed through the GUI. The operator must have the ability to scroll through the entire 'live' graphic program, as necessary.

C. Debugging Software:

1. Provide a search capability that will search all control sequences for a given point name to determine all sequences that use or control the point.
2. The control programs shall be capable of being tested on-line or off-line (prior to installation in field panels). The program and results of programming tests shall be displayed graphically using graphical programming language with parameter values displayed in appropriate locations. Simulation capabilities shall include step-by-step, accelerated time, and operator defined simulation criteria like outside weather, demand, and communication status.

## 2.4 MISCELLANEOUS SOFTWARE

A. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide relevant data for the application or object that help is being called from.

B. Provide software for viewing (but not editing) electronic versions of as-built shop drawings of:

1. Mechanical, electrical, and plumbing systems in AutoCAD Release 14 or 2000+ format.
2. EMCS drawings in format selected by contractor (see limitations in Section 230900).

# PART 3 - EXECUTION

## 3.1 SYSTEM CONFIGURATION

A. Contractor shall thoroughly and completely configure EMCS system software, supplemental software, network software etc. on CSS, POTs, and servers.

## 3.2 POINT STRUCTURING AND NAMING

A. The intent of this section is to require a consistent means of naming points across the Campus EMCS. Contractor shall configure the systems from the perspective of the Campus EMCS, not solely the local project. The following requirement establishes a standard for naming points and addressing Buildings, Networks, Devices, Instances, etc.

B. Point Summary Table:

1. The term 'Point' includes all physical I/O points, virtual points, and all application program parameters.
2. With each schematic, Contractor shall provide a Point Summary Table listing:

    a. Building number and abbreviation.
    b. System type.
    c. Equipment type.
    d. Point suffix.
    e. Full point name (see Point Naming Convention paragraph).
    f. Point description.
    g. Ethernet backbone network number.
    h. Network number.
    i. Device ID.
    j. Device MAC address.
    k. Object ID (object type, instance number).
    l. Engineering units.
    m. Device make and model #. Include range of device if model number does not so identify.
    n. Device physical location description. Include floor and column line intersection to one decimal place (e.g. line 6.2 and line A.3)

3. Point Summary Table shall be provided in both hard copy and in a relational database electronic format (ODBC-compliant).
4. The EMCS Contractor shall coordinate with the Owner's representative and compile and submit a proposed Point Summary Table for review prior to any object programming or project startup.
5. The Point Summary Table shall be kept current throughout the duration of the project by the Contractor as the Master List of all points for the project. Project closeout documents shall include an up-to-date accurate Point Summary Table. The Contractor shall deliver to the Owner the final Point Summary Table prior to final acceptance of the system. The Point Summary Table shall be used as a reference and guide during the commissioning process.

C. Point Naming Convention:

1. All point names shall adhere to the format as established below, unless otherwise agreed to by the Owner. New categories and descriptors may be created with approval of the Owner.
2. Format:

    a. Building.Category.System.EquipmentTag.Component.Property.
    b. Example: 001LIB.HVAC.Heatplant.B-1.HWS.Temperature.

| Building | Category | System | Equipment Tag | Component | Property | Typical units |
|---|---|---|---|---|---|---|
| Building number | ELCT | Lighting<br>Plug<br><br>Generator<br>MIsc | (from equipment schedules) | SWITCH<br>PHOTO<br><br>CB<br><br>CWS | Command<br>Status<br><br>Light<br>Power<br>Voltage | On/off<br>On/off<br>Footcan-dles<br>Watts<br>Volts |
| | HVAC | Air handling | | | | |

| Building | Category | System | Equipment Tag | Component | Property | Typical units |
|---|---|---|---|---|---|---|
| | | Exhaust | | CWR | Current | Amps |
| | | Heatplant | | HWS | ValvePos | %open |
| | | Coolplant | | HWR | DamperPos | %open |
| | | Misc | | CHWS | Tempera-ture | °F |
| | PLMB | Dom water | | CHWR | Humidity | %RH |
| | | Air | | OA | Pressure | Psig, " $H_2O$ |
| | | Nat gas | | SA | Flow | Cfm, gpm |
| | | N2 | | RA | Energy | Btu |
| | | O2 | | EA | Speed | %, Hz |
| | | Irrigation | | | Signal | Hz |
| | | Waste | | GAS | | |
| | | Misc | | FLUID | | |
| | MISC | Weather | | | | |

D. Device Addressing Convention:

1. BACnet network numbers and Device Object IDs shall be unique throughout the network.
2. All assignment of network numbers and Device Object IDs shall be coordinated with the Owner.
3. Each Network number shall be unique throughout all facilities and shall be assigned in the following manner unless specified otherwise:

   BBBFF, where: BBB = 1-655 assigned to each building, FF = 00 for building backbone network, 1-35 indicating floors or separate systems in the building.

4. Each Device Object Identifier property shall be unique throughout the system and shall be assigned in the following manner unless specified otherwise:

   XXFFBBB, where: XX = number 0 to 40, FF = 00 for building backbone network, 1-35 indicating floors or separate systems in the building. BBB = 1-655 assigned to each building.

5. The EMCS Contractor shall coordinate with the Owner or a designated representative to ensure that no duplicate Device Object IDs occur.
6. Alternative Device ID schemes or cross project Device ID duplication if allowed shall be approved before project commencement by the Owner.

E. I/O Point Physical Description:

1. Each point associated with a hardware device shall have its BACnet long-name point description field filled out with:

   a. The device manufacturer and model #. Include range of device if model number does not so identify.

b. For space sensors (temperature, $CO_2$, etc.), include room number in which sensor is located.

## 3.3 POINT PARAMETERS

A. Provide the following minimum programming for each analog input:

1. Name.
2. Address.
3. Scanning frequency or COV threshold.
4. Engineering units.
5. Offset calibration and scaling factor for engineering units.
6. High and low alarm values and alarm differentials for return to normal condition
7. High and low value reporting limits (reasonableness values), which shall prevent control logic from using shorted or open circuit values.
8. Default value to be used when the actual measured value is not reporting. This is required only for points that are transferred across the primary and/or secondary controlling networks and used in control programs residing in control units other than the one in which the point resides. Events causing the default value to be used shall include failure of the control unit in which the point resides, or failure of any network over which the point value is transferred.
9. Selectable averaging function that shall average the measured value over a user selected number of scans for reporting.

B. Provide the following minimum programming for each analog output:

1. Name.
2. Address.
3. Output updating frequency.
4. Engineering units.
5. Offset calibration and scaling factor for engineering units.
6. Output range.
7. Default value to be used when the normal controlling value is not reporting.

C. Provide the following minimum programming for each digital input:

1. Name.
2. Address.
3. Engineering units (on/off, open/closed, freeze/normal, etc.)
4. Debounce time delay.
5. Message and alarm reporting as specified.
6. Reporting of each change of state, and memory storage of the time of the last change of state.
7. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.

D. Provide the following minimum programming for each digital input:

1. Name.
2. Address.

3. Output updated frequency.
4. Engineering units (on/off, open/closed, freeze/normal, etc.)
5. Direct or Reverse action selection.
6. Minimum on-time.
7. Minimum off-time.
8. Status association with a DI and failure alarming (as applicable).
9. Reporting of each change of state and memory storage of the time of the last change of state.
10. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.
11. Default value to be used when the normal controlling value is not reporting.

## 3.4 SITE-SPECIFIC APPLICATION PROGRAMMING

A. All site-specific application programming shall be written in a manner that will ensure programming quality and uniformity among the various buildings. The EMCS Contractor will ensure:

1. Programs for all buildings are developed by one programmer, or a small group of programmers with rigid programming standards, to ensure a uniform style.
2. Programs for like functions are identical, to reduce debugging time and to ease maintainability.
3. Programs are thoroughly debugged before they are installed in the field.

B. Massage and tune application programming for a fully functioning system. It is the Contractor's responsibility to request clarification on sequences of operation that require such clarification.

C. All site-specific programming shall be fully documented and submitted for review and approval:

1. Prior to downloading into the panel (see Submittal Package 2 in Section 230900.)
2. At the completion of functional performance testing, and.
3. At the end of the warranty period (see Warranty Maintenance in Section 230900).

D. All programming, graphics and data files must be maintained in a logical system of directories with self-explanatory file names. All files developed for the project will be the property of the Owner and shall remain on the workstations/servers at the completion of the project.

## 3.5 GRAPHIC SCREENS

A. All site-specific graphics shall be developed in a manner that will ensure programming quality and uniformity among the various buildings.

B. Schematics of MEP systems.

1. Schematics shall be 3-D and shall be based substantially on the schematics provided on design drawings.
2. All relevant I/O points and setpoints being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation or color changes shall be used to indicate on/off status of mechanical components. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a pop-up window accessed by selecting the displayed point with the mouse.
3. Animation or equipment graphic color changes shall be used to indicate on/off status of mechanical components.
4. Indicate all adjustable setpoints and setpoint high and low limits (for automatically reset setpoints), on the applicable system schematic graphic or, if space does not allow, on a supplemental linked-setpoint screen.

C. Displays shall show all points relevant to the operation of the system, including setpoints and setpoint limits for setpoints that are automatically reset.

D. The current value and point name of every I/O point and setpoint shall be shown on at least one graphic and in its appropriate physical location relative to building and mechanical systems.

E. Show weather conditions (local building outside air temperature, ands humidity, wind speed, and wind direction) in the upper left hand corner of every graphic.

F. CAD Files: The contract document drawings will be made available to the Contractor in AutoCAD 2010+ format upon request for use in developing backgrounds for specified graphic screens, such as floor plans and schematics. However, the Owner does not guarantee the suitability of these drawings for the Contractor’s purpose.

G. Provide graphics for the following as a minimum:

1. Homepage (Campus, District or Facility Homepage). Background shall be a campus map, approximately to scale. Include links to each building, central plant, domestic water pumping station, etc. Include real-time site utility data such as: building electrical demand, domestic cold water flow, and natural gas demand shown roughly on the map where the utilities connect to the site. Also include kW demand limit values and demand limit level.
2. Building homepage. Background shall be a bldg. footprint, approximately to scale, oriented as in the campus homepage. Include links to each floor and mechanical room/roof, and to summary graphics described below. Include real-time building utility data such as: building electrical demand, chilled water demand (flow and Btu/h), hot water demand (flow and Btu/h), domestic cold water demand, steam demand (if applicable), and natural gas demand (if applicable) shown roughly on the building footprint where the utilities connect to the building.
3. Each occupied floor plan, to scale.

a. HVAC. Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, which provide a visual display of temperature relative to their respective setpoints (see paragraph 2.2G.8). The colors shall be updated dynamically as a zone's actual comfort condition changes. In each zone, provide links to associated terminal equipment.
b. Lighting. Floor plan graphics shall show lighting control zones throughout the buildings in a range of colors, which provide a visual display of temperature relative to their respective setpoints (see paragraph 2.2G.9). The colors shall be updated dynamically as a zone's actual lighting condition changes. In each zone, provide links to associated lighting panel screen to allow manual overrides.
c. If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use elevation views and/or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link graphic building key plan to larger scale partial floor plans. Provide links from each larger scale graphic floor plan screen to the building key plan and to each of the other graphic floor plan screens.

4. Each equipment floor/roof plan, to scale, with links to graphics of all DDC controlled/monitored equipment.
5. Each air handler and fan-coil. Provide link to associated HW and CHW pumping stations where applicable.
6. Each zone terminal. Provide link to associated air handling unit where applicable and to floor plan where terminal is located.
7. Each building pumping station. Provide link to central plant for heating and cooling systems.
8. Plumbing, potable water pumping and domestic water heating system.
9. Potable water, irrigation, and natural gas meter.
10. Lighting panels. Indicate status of each relay and provide links to allow override.
11. Electrical power monitoring system.

    a. Site: Show site single line diagram up to each building ATS, in order to illustrate the 12 KV power distribution and connection of each building to one of the two site circuits. The power flow would change on the diagram (by changing line color and/or width) to show which power line is active into each building as the ATS position is changed. Show ATS status at each building and a link to each building’s electrical system graphic.
    b. For each building: Show a schematic of the electrical system based on one-line diagrams. Show status and power of each switch, breaker, meter, etc. and override buttons for overriding switch positions.

12. Central plant equipment including chilled water system, cooling tower system, hot water system, steam system, generators, etc. The flow path shall change on the diagram (by changing piping line color and/or width) to show which piping has active flow into each boiler, chiller, tower, etc. as valve positions change.

13. Weather station. Show actual, daily, month-to-date, year-to-date, and historical high and low peaks and average temperature, humidity, wind speed, wind direction (average only), and solar radiation.
14. Summary graphics. Provide a single text-based page (or as few as possible) for each of the following summary screens showing key variables listed in columns for all listed equipment:

    a. For each building:

        1) Air handling units: operating mode, on/off status, supply air temperature, supply air temperature setpoint, fan speed, duct static pressure, duct static pressure setpoint, outdoor air damper position, coil valve positions
        2) Zone terminal units: operating mode, airflow rate, zone temperature, zone temperature setpoint, damper position, supply air temperature (reheat boxes), supply air temperature setpoint (reheat boxes), fan status (fan-powered boxes), fume hood status and exhaust airflow rate (laboratory).
        3) Electrical meters and switches: Volts, current, kW, switch positions.

15. All other DDC controlled/monitored equipment.

H. Alarms: Each programmed alarm shall appear on at least one graphic screen. In general, alarms shall be displayed on the graphic system schematic screen for the system that the alarm is associated with (for example, chiller alarm shall be shown on graphic cooling system schematic screen). For all graphic screens, display analog values that are in a 'high alarm' condition in a red color, 'low alarm' condition in a blue color. Indicate digital values that are in alarm condition in a red color.

## 3.6 POT SOFTWARE

A. Direct Panel Access:

1. One of the POTs shall be configured to access BCs and AACs by directly connecting to these panels without having to connect to the CSS via the network. The purpose of this requirement is to provide access to building EMCS panels in case the Supervisory LAN is down.
2. At the end of commissioning and then again at the end of the warranty period, fully synchronize the database on this POT with that on the CSS.

B. Temporary Interface prior to Acceptance:

1. Point database and control programming shall not be installed on and merged with that on the CSS until the system is fully commissioned and accepted by the Owner. During this phase, the Contractor shall provide a temporary POT configured with proper

software for this purpose, connected to the EMCS locally at the building.

2. Once the EMCS has been accepted by the Owner, merge the database and control programming with existing systems on the CSS.

C. TAB Coordination:

1. Software shall be provided free of charge on at least a temporary basis to the TAB contractor to allow them to calibrate terminal box airflow controls and other work specified under Section 230593 Testing, Adjusting, and Balancing.
2. Software may be provided for installation on POT provided by TAB contractor or Contractor shall loan a POT or hand-held device with software installed to the TAB contractor for the duration of TAB work.
3. Provide sufficient training to the TAB contractor to allow them to use the software for balancing and airflow calibration purposes. Contractor shall include a single training session; additional training due to changes in TAB personnel shall be paid for by the TAB contractor.

END OF SECTION

SECTION 23 09 33 – EMCS COMMISSIONING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 WORK INCLUDED

A. Provide the following:

1. EMCS and equipment testing and start-up.
2. Validation of proper and thorough installation of EMCS and equipment.
3. Functional testing of control systems.
4. Demonstration testing of control systems.
5. Documentation of tests, procedures, and installations.
6. Coordination of EMCS training.
7. Documentation of EMCS Operation and Maintenance materials.

B. Refer to Section 230900 for general requirements.

### 1.3 RELATED WORK AND REQUIREMENTS

A. Other EMCS Sections:

1. Section 230900 Energy Management and Control System (EMCS) - General
2. Section 230913 EMCS Basic Materials and Devices
3. Section 230916 EMCS Operator Interfaces
4. Section 230919 EMCS Field Panels
5. Section 230923 EMCS Communication Devices
6. Section 230926 EMCS Software and Programming

### 1.4 COORDINATION

A. Assist Architect (or Commissioning Coordinator), including attending commissioning meetings.

B. Testing, Adjusting, and Balancing:

1. Coordinate with TAB contractors in test and balance work as specified in Section 230593 Testing, Adjusting, and Balancing for

HVAC. A significant number of balancing procedures require the EMCS to be operational and require Contractor time to assist the TAB contractor in their work.

C. Coordinate with Division 21, 22 and 23, and 26 contractors in the performance of pre-functional, functional, and post-occupancy commissioning activities.

## 1.5 SEQUENCING

A. The following list outlines the general sequence of events for submittals and commissioning:

1. Submit Submittal Package 1 (Hardware and Shop Drawings) and receive approval.
2. Initiate installation of EMCS hardware, devices, and wiring.
3. Develop point database and application software.
4. Simulate sequencing and debug programming off-line to the extent practical.
5. Submit Submittal Package 2 (Programming and Graphics) and receive approval.
6. Complete installation of EMCS hardware, devices, and wiring.
7. Install point database and application software in field panels.
8. Submit Submittal Package 3 (Functional Testing) and receive approval.
9. Perform EMCS Pre-functional Tests (start up, calibration and tuning) and submit Pre-functional Tests for approval.
10. Field test application programs prior to functional testing.
11. Receive EMCS Pre-functional Test Report approval and approval to schedule Functional Tests.
12. Prepare and initiate commissioning Trend Logs.
13. Assist TAB contractor in TAB tests and determining setpoints as specified in Section 230950.
14. Perform and record functional tests and submit Functional Test Report for approval.

    a. Some tests may not be possible due to weather conditions. These tests may be deferred to post-occupancy period.

15. Submit Package 4 (Training Materials) and receive approval.
16. Receive EMCS Functional Test Report approval and approval to schedule Demonstration Tests.
17. Perform Demonstration Tests to Commissioning Coordinator and Architect and submit Demonstration Test Report.
18. Receive acceptance of Demonstration Tests.
19. Train Owner personnel on EMCS operation and maintenance.
20. Substantial Completion.
21. Submit Package 5 (Post-Construction Trend Logs) in format specified for review and approval.
22. Receive approval of successful Trend Log tests, or retest as required.

23. Complete all items in Completion Requirements per Section 230900.
24. Provide administration level password access to the Owner.
25. Final Acceptance.
26. Begin Warranty Period.
27. Prepare and initiate post-occupancy Trend Logs.
28. Perform deferred alternate season functional tests and submit amended Functional Test Report for approval.
29. Receive amended EMCS Functional Test Report approval.
30. Two months prior to end of Warranty Period, submit Package 6 (End-of-Warranty Trend Logs) in format specified for review and approval.
31. Receive approval of successful Trend Log tests, or retest as required.
32. Revise and submit record documents and O&M Manuals.
33. Update all software as specified.
34. End of Warranty Period.

## 1.6 FUNCTIONAL TEST DOCUMENTATION

A. Pre-functional Tests:

1. Prepare forms to document the proper startup of the EMCS.
2. All equipment shall be included test forms including but not limited to:

    a. Wiring: End-to-end checkout of all wiring at terminations. Power to all controllers and actuators. Confirmation of emergency power where specified.
    b. Digital Outputs: proper installation, normal position, response to command at CU
    c. Digital Inputs: proper installation, device test, response at CU.
    d. Analog Outputs: proper installation of devices, verification of maximum and minimum stroke.
    e. Analog Inputs: proper installation of sensors, calibration.
    f. Panels: Confirmation of location, power source (electrical circuit used), confirmation of emergency power where specified.
    g. Alarms and Safeties: Verification of alarm routing to all specified devices and correct hierarchy. Example: confirm alarm routing to cell phones, email, servers, remote workstations. Confirm that appropriate alarm levels are routed to appropriate devices.
    h. Loop Tuning: Document setting of P/I parameters for all loops, chosen setpoints, time delays, loop execution speed.
    i. Network Traffic: Document speed of screen generation, alarm, and signal propagation in system with all required commissioning trends active.

3. Each form shall have a header or footer where the technician performing the test can indicate his/her name and the date of the

test.
4. Submit forms for approval in Submittal Package 3.
5. Complete work, document results on forms, and submit for approval as Pre-Functional Test Report.

B. Functional Tests:

1. Architect will prepare functional testing forms after Submittal Package 2 has been reviewed and approved. Tests will be designed to test all sequences in a formal manner with simulations and expected outcomes.
2. Review tests and recommend changes that will improve ease of testing or avoid possible system damage, etc.
3. Adapt forms from Architect into electronic format. Each form shall have a header or footer where the technician performing the test can indicate his/her name and the date of the test.
4. Complete work, document results on forms, and submit for approval as Functional Test Report.

C. Assist Commissioning Coordinator/Architect as specified including attending commissioning meetings.

## PART 2 - PRODUCTS

### 2.1 INSTRUMENTATION

A. Instrumentation required to verify readings, calibrate sensors, and test the system and equipment performance shall be provided by Contractor.

B. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding 6-month period. Certificates of calibration shall be submitted.

C. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is ±0.5% accurate, test equipment shall be ±0.25% accurate over same range).

## PART 3 - EXECUTION

### 3.1 PRE-FUNCTIONAL TESTS

A. General:

1. Inspect the installation of all devices. Review the manufacturer’s installation instructions and validate that the device is installed in accordance with them.

2. Verify proper electrical voltages and amperages and verify that all circuits are free from faults.
3. Verify integrity/safety of all electrical connections.
4. Verify that shielded cables are grounded only at one end.
5. Verify that all sensor locations are as indicated on drawings and are away from causes of erratic operation.
6. Ensure that minimum speed settings programmed into variable speed drive are at or below the minimum speed settings in control sequences.

B. Digital Outputs:

1. Verify that all digital output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

C. Digital Inputs:

1. Adjust setpoints, where applicable.

    a. For current switches used as status on fans, adjust current setpoint so that fan status is "off" when fan discharge damper (if present) is fully closed and when belt is broken (temporarily remove belt).
    b. For current switches used as status on pumps, adjust current setpoint so that pump status is "off" when pump is dead-headed (temporarily close discharge valve).
    c. For differential pressure sensors on pumps and fans, set so that status is on when pump operating with all valves open (out on its curve).

D. Analog Outputs:

1. Verify start and span are correct and control action is correct.
2. Check all control valves and automatic dampers to ensure proper action and closure. Make any necessary adjustments to valve stem and damper blade travel.
3. Check all normal positions of actuators with spring return.
4. For outputs to reset other manufacturer's devices (for example, chiller setpoint) and for feedback from them, calibrate ranges to establish proper parameters.

E. Analog Input Calibration:

1. Sensors shall be calibrated as specified on the points list. Calibration methods shall be one of the following:

    a. Factory. Calibration by factory, to standard factory specifications. Field calibration is not required.
    b. Handheld. Field calibrate using a handheld device with accuracy meeting the requirements of Paragraph 2.1.
    c. Drywell Bath. Field calibrate using a 2-point procedure,

using a drywell calibrator block constructed for that purpose, or an ice bath with a reference standard.

2. The calibrating parameters in software (e.g. slope and intercept) shall be adjusted as required. A calibration log shall be kept and initialed by the technician showing date and time, sensor and hand-held readings, and calibration constant adjustments and included in the Pre-functional Test Report.
3. Inaccurate sensors must be replaced if calibration is not possible.

F. Alarms and Interlocks:

1. A log shall be kept and initialed by the technician showing date and time, alarm/interlock description, action taken to initiate the alarm/interlock, and resulting action, and included in the Pre-functional Test Report.
2. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
3. Coordinate with Division 26 to test fire and life safety systems alarm contacts.
4. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
5. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

G. Variable Frequency Drive Minimum Speed:

1. Minimum speed for VFD-driven fans and pumps shall be determined in accordance with this Paragraph. Tests shall be done for each piece of equipment, except that for multiple pieces of identical equipment used for identical applications, only one piece of equipment need be tested with results applied to all. Note that for fans and pumps, there is no minimum speed required for motor cooling. Power drops with cube of speed, causing motor losses to be minimal at low speeds.
2. The work shall be done only after fan/pump system is fully installed and operational.
3. Determine the minimum speed setpoint as follows:

    a. Start the fan or pump.
    b. Manually set speed to 6 Hz (10%) unless otherwise indicated in control sequences. For cooling towers with gear boxes, use 20% or whatever minimum speed is recommended by tower manufacturer.
    c. Observe fan/pump in field to ensure it is visibly rotating.

        1) If not, gradually increase speed until it is.

    d. The speed at this point shall be the minimum speed setpoint

for this piece of equipment.

e. Record minimum speeds in log and store in software point as indicated on drawings.

H. Tuning:

1. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the Pre-functional Test Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted):

| Controlled Variable | Control Accuracy |
|---|---|
| Duct Pressure | ±0.1" w.g. |
| Building and relief plenum | ±0.01" w.g. |
| Airflow and waterflow | ±10% |
| Space Temperature | ±1.5°F |
| Chilled Water Temper-ature | ±1°F |
| Hot Water Temperature | ±3°F |
| Duct Temperature | ±2°F |
| Water Differential Pressure | ±1.5 psi |
| Others | ±2 times reported accuracy |

I. Interface and Control Panels:

1. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the Record Drawings.
2. Ensure that terminations are safe, secure, and labeled in accordance with the Record Drawings.
3. Check power supplies for proper voltage ranges and loading.
4. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
5. Check for adequate signal strength on communication networks.
6. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
7. Ensure that buffered and/or volatile information is held through power outage.
8. With all system and communications operating normally, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.

9. Check for adequate grounding of all DDC panels and devices.

J. Operator Interfaces:

1. Verify that all elements on the graphics are functional and are properly bound to physical devices and/or virtual points, and that hot links or page jumps are functional and logical.
2. Verify that the alarm printing, logging, paging, emailing etc. is functional and per requirements.

K. Trending/Network Traffic Test. Perform this test to verify that system has been design adequately to simultaneously capture trends and allow proper operation of the control system.

1. The test shall be performed after the verification trends (see paragraph 3.5A) have been set up and are operational.
2. Test 1:

a. Randomly select a device whose failure will generate a Level 1 or 2 alarm and manually shut it off. The status points for the device must indicate the change of state of the device at the Operator Workstation within 5 seconds.
b. The test shall be repeated for four devices in each building.

3. Test 2:

a. A clock signal from a field controller randomly selected will be sent as a programmable point to up to 3 BCs. The clock signal stored in BCs shall be sampled with the rest of the trend data. The system shall be considered acceptable if these clock signals are no more than 2 seconds off of the system clock as sampled concurrently during data collection.

4. If the system fails any test, the system architecture shall be revised as required (e.g. more trend memory, more controllers with trend storage capability, network repeaters to allow an increase in network speed, etc.) followed by additional tests.

## 3.2 TESTING, ADJUSTING, AND BALANCING (TAB) COORDINATION

A. Coordinate with Work performed under Section 230593 Testing, Adjusting, and Balancing for HVAC. Some balancing procedures require the EMCS to be operational and require Contractor time and assistance.

B. Calibration Software:

1. Software shall be provided free of charge on at least a temporary basis to allow calibration of terminal box airflow controls and other Work specified under Section 230593 Testing, Adjusting and Balancing for HVAC.
2. Software shall be provided for installation on POT(s) provided by

Others or Contractor shall loan a POT or handheld device with software installed for the duration of Work specified under Section 230593 Testing, Adjusting, and Balancing for HVAC.

3. Provide sufficient training to those performing Work specified under Section 230593 Testing, Adjusting, and Balancing for HVAC to allow them to use the software for balancing and airflow calibration purposes. Contractor shall include a single training session for this purpose.

C. Setpoint Determination:

1. Perform pre-functional tests described in the specifications before assisting in setpoint determination.
2. Coordinate with Work performed under Section 230593 Testing, Adjusting, and Balancing for HVAC to determine fan and pump differential pressure setpoints, outdoor air damper minimum positions and DP setpoints, etc. as indicated in Section 230950 Testing, Adjusting and Balancing for HVAC.

D. Coil Valve Leak Check:

1. Coordinate test procedures with those outlined in Section 230593Testing, Adjusting and Balancing for HVAC to provide control valve leak check tests.
2. Test conditions for each hydronic system:

a. Tests shall be done when central plant cooling and heating systems are operational.
b. Close all control valves.
c. Start all fans associated with control valves.
d. Open bridge connection control valve.
e. Start both pumps.
f. Observe flow meter. If reading changes after pumps start, there is a leaking valve.
g. Observe supply air temperature at each coil after test starts.
h. Should any supply air temperature rise, close the isolation valves to the coil to see if temperature changes. If so, this validates the valve is not fully closing.
i. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat, or replacing the valve as applicable.

## 3.3 FUNCTIONAL TESTS

A. Test schedule shall be coordinated with the Commissioning Authority, Commissioning Coordinator and/or Architect.

B. Functional tests may be witnessed by the Architect at the Owner’s option.

C. All approved Functional Tests shall be conducted by the Contractor with results confirmed and signed by the Contractor's start-up technician.

1. Seasonal Impacts: It shall be assumed that not all tests will be possible due to weather conditions. Those that are not possible shall be deferred until the next season, performed during the warranty period.

D. Test documentation shall be submitted to the Owner for review and approval.

## 3.4 DEMONSTRATION TEST

A. Demonstration tests consist of a small representative sample of functional tests and systems randomly selected by the Owner. Tests will be designed to occur over no longer than ***2*** days.

B. Schedule the demonstration with the Architect 1 week in advance. Demonstration shall not be scheduled until the Functional Test Report has been approved.

C. The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc. Contractor-supplied personnel shall be those who conducted the Functional tests or who are otherwise competent with and knowledgeable of all project-specific hardware, software, and the HVAC systems.

D. The system will be demonstrated following procedures that are the same or similar to those used in the Pre-Functional and Functional Tests. The Architect will supply the test forms at the site at the start of the tests.

E. Demonstration tests may be witnessed by the Architect at the Owner's option.

F. Contractor shall conduct tests as directed by and in the presence of the Architect and complete test forms. Completed forms shall be submitted as the Demonstration Test Report to the Owner and Commissioning Coordinator after tests are complete.

G. Demonstration Tests shall be successfully completed and approved prior to Substantial Completion.

## 3.5 TREND LOG TESTS

A. Trends shall be fully configured to record and store data to the OWS or server for the points and at the interval listed on drawings as follows:

1. Commissioning: Configure trends prior to functional testing phase. Retain configuration until post-construction trend review has been completed successfully and accepted by the Architect. Trends shall be deactivated after acceptance.
2. Continuous: After system acceptance, configure trends for the purpose of long-term future diagnostics. Configure trends to overwrite the oldest trends at the longest interval possible without filling the server hard disk beyond 80%.

B. Commissioning (Post Construction) Trend Test.

1. Trend logging shall not commence until Demonstration Tests are successfully completed.
2. Hardware Points: Contractor shall configure points to trend as indicated in the Commissioning Trend column listed on drawings points list with the following qualifications.

    a. For equipment of identical function, such as VAV zones and AHUs with identical components and control sequences, only a sample of such equipment need be trended. The sampling shall be 10% of the identical components, but no more than 10 and no less than three. Review with Architect before setting up trends.
    b. All points trended for one HVAC subsystem (e.g. air handling unit, chilled water system, etc.) shall be trended during the same trend period and the same time intervals so that data may be easily plotted using a spreadsheet.

3. Software Points: Include the following in trends of systems and zones whose hardware points are being trended as called for above. Time interval shall be the same as associated hardware point.

    a. All setpoints and limits that are automatically reset, such as supply air temperature and fan static pressure setpoints, plus the points that are driving the reset, such as zone level cooling and static pressure requests.
    b. All setpoints that are adjustable by occupants.
    c. Outputs of all control loops, other than those driving a single AO point that is already being trended.
    d. System mode points (e.g. Warm-up, Occupied, etc.).
    e. Global overrides such as demand shed signals.
    f. Calculated performance monitoring points, such as chiller efficiency.

4. Submit for review and approval by the Commissioning Authority and/or Architect a table of points to be trended along with trend intervals or change-of-value a minimum of 14 days prior to trend collection period.
5. Trends shall be uploaded to the OWS or Server in data format specified in Section 230926.
6. Trend logs of all points indicated above shall be collected for a

3-week Trend Period.

7. At the completion of the Trend Period, data shall be reviewed by the Contractor to ensure that the system is operating properly. If so, data shall be submitted to the Architect in an electronic format agreed to by the Owner and Contractor (e.g. CD-ROM or via direct access to the OWS or server via the internet).
8. Data will be analyzed over approximately a two- to three-week period by the Commissioning Authority and/or Architect.
9. The system shall be accepted only if the trend review indicates proper system operation without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. If any but very minor glitches are indicated in the trends, steps 4 to 6 above shall be repeated for the same Trend Period until there is a complete Trend Period of error free operation.

C. Post Occupancy Trend Tests.

1. After successfully completing the Commissioning Trend Tests, the Contractor shall configure all points to trend as indicated in the Continuous Trend column listed on drawings points list.
2. Archive trends up to the OWS or server without overwriting stored data for the entire Warranty Period.
3. The system shall be accepted, and warranty period considered complete only if the trend review indicates proper operation without malfunction without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. If any but very minor glitches are indicated in the trends, steps above shall be repeated until there is a complete Trend Period of error free operation.

## 3.6 REMEDIAL WORK

A. Repair or replace defective Work, as directed by Architect in writing, at no additional cost to the Owner.

B. Restore or replace damaged Work due to tests as directed by Architect in writing, at no additional cost to the Owner.

C. Restore or replace damaged Work of others, due to tests, as directed by Architect in writing, at no additional cost to the Owner.

D. Remedial work identified by site reviews, review of submittals, demonstration test, trend reviews, etc. shall be performed to the satisfaction of the Architect, at no additional cost to the Owner.

E. Contractor shall compensate Architect and Commissioning Authority on a time and material basis at standard billing rates for any additional time required to witness additional demonstration tests or to review

additional EMCS trends beyond the initial tests, at no additional cost to the Owner.

## 3.7 TRAINING

A. Coordinate schedule and materials with Architect and/or Commissioning Authority.

B. Interim Training:

1. Provide minimal training so the operating staff can respond to occupant needs and other operating requirements during start-up and commissioning phase.

C. Formal Training:

1. Provide training sessions at locations and for personnel indicated below.
2. Training shall be conducted after all commissioning is complete and systems are fully operational.
3. The length of each training period will depend on the complexity of the system and the audience, described below. Minimum training shall be as listed below, but period shall be longer if required to complete the training tasks described below.

    a. On site job training: Include 40 hours total of on-site training to assist personnel in becoming familiar with site-specific issues, systems, control sequences, etc. (including general EMCS system training).

4. Training may be in non-contiguous days at the request of the Owner.
5. Contractor shall be video training sessions, see Section 230010 Mechanical General Provisions.
6. During the warranty period, provide unlimited telephone support for all trained operators.

D. Operators are divided into three categories and shall receive training including but not limited to the tasks listed.

1. Day-to-day Operators shall be trained to:

    a. Proficiently operate the system.
    b. Understand control system architecture and configuration.
    c. Understand EMCS system components.
    d. Understand system operation and control sequences.
    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 schedules, and holiday schedules.

i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
j. Understand and acknowledge alarms.
k. Understand system drawings, and Operation and Maintenance manual.
l. Understand the Project layout and location of control components.
m. Print point and predefined reports.

2. Advanced Operators shall be trained to do all items for Day-to-day operators plus:

a. Make and change graphics on the workstation.
b. Create, delete, and modify alarms, including annunciation and routing.
c. Create, delete, and modify point trend logs, and graph or print these both on an ad-hoc basis and at user-definable time intervals.
d. Create, delete, and modify reports.
e. Add, remove, and modify system's physical points.
f. Create, modify, and delete programming.
g. Add control panels.
h. Add Operator Workstations.
i. Create, delete, and modify system displays — both graphical and otherwise.
j. Perform EMCS system field checkout procedures.
k. Perform EMCS controller unit operation and maintenance procedures.
l. Perform workstation and peripheral operation and maintenance procedures.
m. Perform EMCS system diagnostic procedures.
n. Configure hardware including PC boards, switches, communication, and I/O points.
o. Maintain, calibrate, troubleshoot, diagnose, and repair hardware.
p. Adjust, calibrate, and replace system components.
q. Maintain software and prepare backups.

3. System Managers/Administrators shall be trained to do all items for Day-to-day operators plus:

a. Maintain software and prepare backups.
b. Create and print custom reports, including tenant billing summaries.
c. Interface with job-specific, third-party operator software.
d. Add new users and understand password security procedures.

E. Training materials shall include step-by-step instructions (including illustrations, screen captures, etc.) for how to perform all task identified in herein such that a new Operator, who has not attended the training in person and has minimal familiarity with this EMCS system, can easily follow the instructions and successfully perform

all of the identified tasks. One copy of training material shall be provided per student. An electronic copy of the materials shall be stored on the OWS.

F. The instructor(s) shall be factory-trained instructors experienced in presenting this material.

G. The type and number of personnel and location for training shall include.

1. Day-to-day Operator: 2.
2. Advanced Operator: 1.
3. System Managers/Administrators: 1.

END OF SECTION

SECTION 23 21 13 - HYDRONIC PIPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section includes special-duty valves and specialties for the following:

1. Water source heat pump loop / condenser water piping.
2. Auxiliary and intermediate drain pan piping.

### 1.3 REFERENCE STANDARDS

A. ASME B31.1 or B31.9 as applicable for shop and project site welding of piping work.

B. ASTM A53 – Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

C. ASTM A120 – Pipe, Steel, Black, Welded and Seamless, for Ordinary Uses.

D. ASTM A234 – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

E. ANSI/ASME SEC 9 – Welding and Brazing Qualifications.

F. ANSI/ASME B16.3 – Malleable Iron Threaded Fittings Class 150 and 300.

G. ANSI/ASME B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

H. ANSI/ASME B16.26 – Cast Copper Alloy Fittings for Flared Copper Tubes.

I. ANSI/ASTM B32 – Solder Metal.

J. ANSI/ASTM B88 – Seamless Copper Water Tube.

K. ASTM B280 – Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

L. ANSI/AWS A5.8 – Brazing Filler Metal.

M. ANSI/AWS D1.1 – Structural Welding Code.

1.4 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Piping materials | R | | | R |
| Pipe fittings | R | | | |
| Solder | R2 | | | |

1.5 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. 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 1.

B. Welding materials and labor to conform to ASME Code and applicable state Labor Regulations.

C. Use welders fully qualified and licensed by state authorities.

D. Each length of pipe, fitting, trap, fixture, or device used in any piping system shall be stamped or indelibly marked with.

1. Weight or quality.
2. Maker's name or mark.

E. Examine piping layouts and determine requirements for piping offsets, loops, or expansion joints to adequately protect systems.

1. Determine locations and design of anchors and pipe guides to maintain proper piping alignment.
2. Determine anchor reaction forces and coordinate locations of anchors with Architect.

F. Conform to ANSI/ASME B31.1

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Welding Fittings.

1. Babcock and Wilcox Tubular Products Division.
2. Bonney Forge Foundry, Inc.
3. Landish Company.
4. Or equal.

C. Flange Gaskets.

1. John Crane Company.
2. Garlock Mechanical Packing Division.
3. Goodrich.
4. Or equal.

D. Solder.

1. Westinghouse.
2. J.W. Harris Co., Inc.
3. Engelhard.
4. Or equal.

E. Pipe Joint Compound.

1. Rectorseal.
2. Permatec.
3. John Crane.
4. Or equal.

2.2 PIPING AND FITTINGS

A. General.

1. Piping shall.

a. Be commercially round and straight.
b. Be of uniform quality and workmanship.
c. Be free from all defects.
d. Be identified.

B. Pressure Piping.

1. Pressure piping shall conform to requirements of ANSI Safety Code for Pressure Piping, B31.1.
2. Type PP-1: Black Steel: Schedule 40 or Standard Weight, ASTM A53 Type E Grade B (electric resistance welded).

a. 2-1/2 inches and larger.
b. Welded joints.

1) Steel welding-neck fittings, ANSI B16.9-93.
2) Steel welding-neck flanges and flanged fittings, ANSI B16.5-88, 150 pounds per square inch.

c. 0.375 inch wall for sizes 12 inch and larger.

3. Type PP-2: Copper Tubing.

a. 2 inches and smaller.
b. ANSI H23.1; Type L or K.
c. Hard temper unless indicated otherwise.
d. Wrought-copper, solder joint fittings, ANSI B16.22, in sizes available.
e. Cast-bronze solder-joint fittings, ANSI B16.18, only in sizes not available in wrought copper.
f. Cast-bronze, threaded, ground-joint unions, ANSI B16.15, 2 inches and smaller.
g. Cast bronze, flanged unions, ANSI B16.24, 150 pounds per square inch class, 2-1/2 inches and larger.

C. Fittings and Flanges: Standard products of respective manufacturer of piping as hereinbefore specified.

D. Flange Gaskets.

1. Full faced or flat ring type to suit flange facings, selected from one of following materials.
2. Gaskets for flanged joints shall comply with ANSI B16.21.
3. Full faced for cast iron flanges.
4. Raised face for steel flanges.

a. Red rubber, ASTM D1330.
b. 1/16 inch thick.
c. Equal to Crane Style 555.

5. Gaskets coated with thread lubricant when being installed.

E. Flange Bolts: Open-hearth bolt steel.

F. Unions.

1. Steel Piping 2 inches and smaller.

a. 250 pounds per square inch: ground joint.
b. Equal to Grinnell Fig. 554.

2. Steel Piping Larger than 2 inches: Welding flanges.
3. Copper Piping: Equal to Nibco No. 633.

G. Dielectric Connections.

1. Unions.

a. Only allowed where union is required elsewhere in specifications or on drawings. Use nipple specified below otherwise.
b. 2 inches and smaller.

1) 250 pounds per square inch water on gage (WOG).
2) Standard gaskets for plumbing.
3) High temperature gaskets for heating.
4) Equal to EPCO Model FX.

c. 2-1/2 inches and larger.

1) Brass.

a) Brass half-union, ANSI B16.1, 1989, 175 pounds per square inch water on gage (WOG).
b) To welding flange as hereinbefore specified.
c) Equal to EPCO Model X.

2) Copper.

a) Half union with EPDM insulator gasket.
b) 150 pounds per square inch water on gage (WOG).
c) The Copper component of the flange adapter shall be Third Party Classified by Underwriters Laboratories Inc.

2. Nipples.

a. Applicable to all hydronic systems.

1) Minimum 4 inch long stainless steel, brass, or copper nipple with non-conducting thermo-plastic internal lining.
2) ASTM Standard F-492 for continuous use at temperatures up to 225°F.
3) ClearFlow or equal.

b. Allowed for closed-circuit hydronic systems only: minimum 6 inch long brass nipple.

## 2.3 PIPING SPECIALTIES

A. See Section 232116 “Hydronic Piping Specialties”.

## 2.4 SOLDER

A. S-1: Silfos or Silvaloy 15 silver solder (brazing) with 15 percent silver, 80 percent copper and 5 percent phosphorous.

B. S-1A: Safety Silv 56 cadmium-free silver solder (brazing) with 55 to 57 percent silver, 21 -23 percent copper, 15 to 19 percent zinc, 4 to 6 percent tin, and 0.15 percent other metals.

C. S-2, either.

1. 95 percent tin 5 percent antimony solder, lead free, or.
2. 95.6 percent tin, 4 percent copper, 0.4 percent silver, lead free.

## PART 3 - EXECUTION

### 3.1 PIPE SERVICES

| Service | Type of Pipe | Remarks |
|---|---|---|
| Above Ground Hydronic (Water source heat pump loop / CW) | PP-1; PP-2 Type L Hard | to 250 degrees Fahrenheit |
| Auxiliary pan drains | PP-2 Type M Hard | |
| Chemical water treatment and filtration systems | PP-3 Schedule 80 | |

### 3.2 INSTALLATION

A. Coordinate with work of other trades.

B. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leak resistant piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes, where indicated by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance.

C. Install underground piping per manufacturer’s instructions.

D. Arrangement.

1. Except for large scale details piping is diagrammatically indicated. Install generally as shown.
2. Do not scale drawings for exact location of piping.
3. Install piping to best suit field conditions, in coordination with other trades.
4. Piping Arrangement.

    a. Arrange piping neatly along walls.
    b. In neat, horizontal groups.
    c. Each group to be in one plane, insofar as possible.
    d. Maintain required slope.

5. Do not sleeve structural members without consent of the Architect.

6. Maintain maximum 1-inch clearance from adjacent work, including insulation, except as noted.
7. Install piping concealed above ceilings or in walls unless otherwise indicated.
8. Installation of piping shall be made with use of appropriate fittings. Bending of piping will not be allowed.
9. Unions installed shall be accessible.
10. Locate piping runs vertically and horizontally; avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. In finished and occupied spaces, conceal piping from view by locating in column enclosures, in hollow wall construction, or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.
11. Electrical equipment spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless the piping serves equipment in the room.
12. Use tapered reducers where any change in pipe size occurs. Bushings shall not be used.
13. Conceal piping in finished portions of building, above the floor line. Cutting of walls and floors shall be held to the minimum possible to secure the proper installation.
14. Provide concealed high points with air chambers with 1/4-inch copper tube vent line and stop cock carried to accessible point.
15. Install piping subject to expansion or contraction in a manner permitting strains to be evenly distributed and alleviated.
16. Pipe the discharge of each relief valve, air vent, backflow preventer, and similar device to floor sink or drain.

E. Installation of Protective Pipe Wrap.

1. Wrap pipe and fittings with two layers of protective wrap according to manufacturer’s instructions. Over-lap each layer of warp minimum 1/2 inch. Extend wrap three feet beyond section underground.
2. Protect all steel pipe buried in ground from corrosion by the application of protective pipe wrap. Clean and prime piping before application of the wrapping material.
3. No rocks or sharp edges shall be backfilled against the wrap. When backfilling with other than sand, protect wrap with an outer wrapping of Kraft paper; leave in place during backfill.
4. Wrap all copper piping below grade or concrete with plastic sleeve.

## 3.3 EXPANSION CONTROL

A. General.

1. Install piping to permit free expansion and contraction without damaging piping or construction.
2. Provide offsets, expansion loops, anchors, guides, and supports to permit expansion, within stress limits of ANSI 31.1 Pressure Piping for temperature ranges specified.
3. Where pipe loops or changes in direction of piping cannot be employed to absorb expansion and contraction, provide expansion joints.
4. Install pipe guides so that movement takes place along axis of pipe only. Pipe moves laterally at expansion elbows.

5. Make riser offsets in manner to avoid pocket forming due to expansion.

6. Structural Considerations

a. Install pipe anchors to provide required restraints on expanding piping systems.
b. Install pipe guides to provide required restraints against lateral action of expanding piping systems.

1) Spacing for expansion joints: per manufacturer's recommendations.
2) Spacing for pipe loops and/or offsets: as required to maintain alignment within allowable stress limits.

c. Locate anchors and guides only at building structural members capable of taking imposed reaction loads.
d. Determine horizontal and vertical reaction loads of anchors and guides to building structure.

1) Coordinate details and reaction loads with structural engineer for building.
2) If necessary, revise location and number of anchors and guides as recommended by structural engineer to result in allowable reaction loads to building.

B. Provision for Expansion.

1. Loops, bends, offsets.

a. As indicated or because of job required relocation of piping and equipment.
b. Design as follows:

1) Use spring type loop U-bend or offset U-bend.
2) Corner radii five to six times pipe diameters.
3) Join bends only by welding.

a) Welding-steel piping.
b) Brazing-copper or bronze piping.

C. Sloping, Air Venting and Draining.

1. Slope piping as indicated, true to line and grade, and free of traps and air pockets.
2. Reducers/increasers.

a. Eccentric.

1) At pump suction where reducer is required.
2) Top side flat.

b. Concentric: All other locations.

3. Connect branch piping to bottom of mains in closed systems.

4. Provide drain valves and hose adapters as indicated on drawings and at the bottom of all risers.
5. Vents: See Section 232116 "Hydronic Piping Specialties."

D. Piping Specialties: See Section 232116 "Hydronic Piping Specialties."

E. Pipe Hanging and Supports: See Section 230529 "Hangers and Supports."

F. Copper.

1. Crimping of copper tubing prohibited.
2. Isolate copper tubing from ferrous materials and hangers with two thicknesses of 1 inch wide 10 mil polyvinyl tape, spiral-wrapped around pipe. Total width shall be a minimum of 3 inches.

G. Coatings: Reapply coal-tar coating on buried piping, after installation, to surfaces from which coating has been removed or scraped.

H. Pipe Identification: See Section 230553 "Mechanical Identification."

I. Care of Floors.

1. Do not set pipe vises or threading machines on unprotected concrete floors.
2. Cover floor when making plumbing connections to avoid staining floors with oil, white or red lead or other substances.
3. Remove any stains at no additional cost to the Owner.

## 3.4 PIPE JOINTING

A. This section does not apply to refrigerant piping.

B. Fittings.

1. Provide standard, manufacturing fittings in all cases.
2. Prohibited fittings.

a. Press-type fittings.
b. Locking type fittings.
c. Field fabricated.
d. Bushings on pressure piping.
e. Clamp-on branch connections.

3. Provide insulating couplings or dielectric unions at all connections of ferrous piping to non-ferrous piping.
4. Branch connections, steel piping.

a. Equal to main and to two pipe sizes smaller: weld tees, same weight as piping.
b. Three or more pipe sizes smaller than main, but 2-1/2 inches and larger: Bonney Weld-o-lets.
c. Two inches and smaller: Bonney Weld-o-lets, Thread-o-lets, threaded Nip-o-lets, or steel couplings.

C. Unions: Provide unions or flanges to render all items in systems easily removable, including.

1. Control valves.
2. Both sides of pumps and equipment.
3. Where indicated on drawings.
4. Exceptions.

    a. Copper water piping 1-inch or less, at Contractor’s options, since the copper can be easily cut, and the union is a less secure joint than a soldered joint.
    b. Where unions are not allowed by code: Unions not allowed.

D. Pipe Ends.

1. Perform pipe cutting and end preparation to result in clean ends with full inside diameter.
2. Grind and ream, as necessary.

E. Nipples.

1. Close nipples not permitted.
2. Provide extra heavy pipe for nipples where unthreaded portion is less than 1-1/2 inch long.

F. Threaded Joints: not allowed other than unions.

G. Welded Joints.

1. Weld pipe joints in accordance with recognized industry practice and as follows:

    a. Welding shall be done by qualified welders in a first-class, workmanlike manner, conforming to the American Standard Code for Pressure Piping USA B-31.1 and B-31.1A.
    b. Bevel pipe ends at a 37.5 degree angle where possible, smooth rough cuts, and clean to remove slag, metal particles, and dirt.
    c. Do not weld-out piping system imperfections by tack-welding procedures; re-fabricate to comply with requirements.
    d. Standards: Conform to Section UI, Chapter 4, "Welding of Pipe Joints", ANSI B31.1 and applicable portion of ASME Boiler and Pressure Vessel Code, Section IX.
    e. Operator's qualifications: All welders engaged in work under this Section shall be qualified in accordance with State requirements. Each operator's certificate shall be on file at site and made available to State upon request. Welding of pressure piping shall be done by-welders who have been qualified by recognized agency within 6 months prior to date of Contract.
    f. Preparation for welding: Bevel piping on both ends before welding; both ends shall have 1-1/6 inch land at bottom of bevel. Pipe with a 3/4 inch wall thickness or less shall be beveled to a standard 37.5 degrees.
    g. Use backing rings on all butt-welding joints 6-inches and larger.

h. State employed Inspector will visually inspect welds. Any weld judged defective by visual inspection shall be cut out and tested in presence of Inspector. If percentage of defective coupons is deemed excessive, contractor shall cut additional coupons as directed by the Architect or the State Inspector. Removal and replacement of test coupons and samplings shall be done at no additional cost to the Owner. At the option of the State Inspector or the Architect, certain welds may be required to be radiographed.

2. Where required, peen and wheel-grind welds.
3. Ends of pipe may be burned for welding.

a. Grind bevel and remove scale between welding joint.
b. Ragged edges with metal beads, poor alignment other inferior work will be rejected.

4. Perform welding with oxyacetylene or electric arc process.

H. Soldered and Brazed Joints.

1. Solder.

a. Use Solder S-1 for underground copper piping.
b. Use Solder S-2 other than above.

2. Clean surfaces to be jointed, of oil, grease, rust and oxides.

a. Remove grease from fittings by washing in solution of 1/16 sodium carbonate and three gallons hot water (except as otherwise specified for medical gas piping).
b. Clean socket of fitting and end of pipe thoroughly with emery cloth to remove rust and oxides.
c. Wipe excess solder from joint before it hardens.

3. When soldering or brazing materials that could be damaged by heat, remove sensitive parts, and protect parts from heat. Joints shall be cool before reassembling valve.
4. Cut tubing square, reamed, and burrs removed.
5. Prevent annealing of fittings and tubing when making connections.

## 3.5 FLASHING AND SLEEVES

A. See Section 230529 “Hangers and Supports.”

## 3.6 CLEANING

A. General.

1. During Construction.

a. Keep openings in piping closed to prevent entrance of foreign matter.
b. Clean pipe, fittings, and valves internally.

c. Hammer welds to remove slag and weld beads.

2. Clean system after pressure test. Do NOT let system sit filled with un-chemically treated water for more than 4-hours.

B. Cleaning Procedure.

1. Upon start-up fill with clean water.
2. Add alkaline detergent.

a. Sodium silicate and/or sodium phosphate with non-foaming wetting agent.
b. Phenolphthalein alkalinity to 2000 to 5000 parts per million as CaCo/3.
c. Supplied and supervised by water treatment company.

3. Install temporary filter bags in line strainers during start-up.
4. Circulate water of each system at respective design flow rates or greater.

a. Three 8-hour periods.
b. At end of each 8-hour period remove and clean strainers and blow off low points.
c. After third period, completely drain out entire systems of cleaning solution and removed filters at strainers.
d. Refill systems with clean water and circulate for additional 8-hour period at end of which interval, completely drain systems.
e. Drain, refill with clear water; circulate.
f. Test for alkalinity.

1) Not more than 200 parts per million in excess of alkalinity of rinsing water.
2) Repeat flushing of water of each system at respective minimum design flow rate as described above, until 200 parts per million or less.

5. Protect against damage from freeze up or discharge of water.
6. Should any pipe be plugged or should foaming of water systems occur, disconnect piping, clean again, and reconnect at no additional cost to the Owner.

C. Upon completion of cleaning, dose system with chemicals to obtain corrosion inhibition conditions as recommended by water treatment company.

## 3.7 FIELD QUALITY CONTROL

A. Testing of Water Piping.

1. Test water piping at completion of roughing in, in accordance with the following schedule and show no loss in pressure or visible leaks after a minimum duration of four hours, or time as indicated, at the test pressures indicated.

2. Make connections to existing systems with flanged connection. During testing of the new work, provide a slip-in plate to restrict test pressure to new systems only. Remove plate and complete connection to existing system at completion of testing.
3. Inspect pressure piping in accordance with procedures of ANSI B31.
4. Less than 100 pounds per square inch operating pressure: Test hydrostatically to 150 pounds per square inch.
5. Over 100 pounds per square inch operating pressure.

    a. Test hydrostatically to 1-1/2 times operating pressure.
    b. Never exceed test pressure ANSI B16.1 basis.

6. Duration: 4 hours.

    a. With system valves capped and pressure apparatus disconnected.

        1) Pressure change: none.
        2) Compensate for temperature change.

7. Leaks and defects.

    a. Repair or replace as directed by the Architect.
    b. At no additional cost to the Owner.

8. Notify Architect in writing one week before test.
9. Furnish written report and certification that tests have been satisfactorily completed to the Architect.
10. Include written report and certification that tests have been satisfactorily completed.
11. Final connection to system shall be witnessed by Architect.

| Hydronic Piping Test Log | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | System | Description of Piping Section Tested | Test Press. (psig) | Test Duration (hours) | Results Pass/ Fail | Witness (Contractor) Initials | Witness (Professional) Initials |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| This form stall be completed and submitted with the project closeout documents. Contractor shall copy this form if more sheets are required. Piping pressure test log shall be kept at project site and shall be made available to the Architect upon request. | | | | | | | |

END OF SECTION

SECTION 23 21 16 - HYDRONIC PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes: Materials, equipment, fabrication, installation, and tests in conformity with applicable codes and authorities having jurisdiction for the following:

1. Strainers.
2. Balancing valves.
3. Safety valves.
4. Air Vents.
5. Test plugs.
6. Flanges.
7. Flex connectors.

### 1.3 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Strainers | R | R | | R |
| Balancing valves | R | R | | R |
| Safety valves | R | R | | R |
| Air vents (manual and automatic) | R | R | | R |
| Test plugs | R | | | |
| Flanges | R | | | |
| Flexible connectors | R | | | R |

1.4 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. 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 1.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Air vents (manual and automatic).

1. AMTROL.
2. Bell & Gossett.
3. Armstrong.
4. Or equal.

C. Strainers.

1. Mueller.
2. Armstrong.
3. Watts.
4. Sarco.
5. Steamflo.
6. Or equal.

D. Balancing valves.

1. Bell & Gossett.
2. Armstrong.
3. Taco.
4. Or equal.

E. Safety valves.

1. Watts.
2. Bell & Gossett.
3. Armstrong.
4. Or equal.

F. Pressure-temperature test plugs.

1. Peterson-Engineering Company.
2. Taco, Inc.
3. Or equal.

G. Flexible connectors.

1. Flex-Weld.
2. Mason Industries.
3. Metraflex. Co.
4. Or equal.

## 2.2 AIR VENTS

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg. F.
8. Bell & Gossett Model 78 or equal.

B. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg. F.
8. Bell & Gossett Model 98 or equal.

## 2.3 STRAINERS

A. Sizes.

1. Screwed ends: to 2 inch.
2. Flanged 2-1/2 inch and larger.

B. Body.

1. To 100 psi: 125 lb. wsp class, cast iron.
2. 100 psi to 250 psi: 250 lb. wsp class, cast iron.
3. Over 250 psi: 300 lb. wsp class, forged steel or cast steel.

C. Screen.

1. 304, 316 stainless steel or Monel, reinforced.
2. Free area not less than 2-1/2 times inlet area.
3. Perforations.

    a. Water.

        1) To 8 inch: 1/8 inch.
        2) 10 inch and larger: 5/32 inch.

D. Y-Type.

1. Cast iron or bronze body as indicated.
2. Screwed.

a. Faced cap, straight thread, and gasket.
b. Mueller Steam Specialty or equal.

1) Steel piping No. 1MFCB.
2) Copper piping No. 35-1/2 M.

3. Flanged.

a. Bolted cover.
b. Mueller Steam Specialty or equal.

1) Steel - 125 psi steam, 200 psi water on gauge (WOG) - No. 751.
2) Steel - 250 psi steam, 500 psi water on gauge (WOG) - No. 752.
3) Copper - 150 psi steam, 225 psi water on gauge (WOG) - No. 851.
4) Copper - 300 psi steam, 500 psi water on gauge (WOG) - No. 852.

E. Basket type.

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. Mueller Steam Specialty Muessco No. 165 or equal.

## 2.4 BALANCING VALVES

A. Calibrated-Balancing Valves:

1. Combination balancing and shut-off valves.
2. Calibrated name plate and adjustable memory stop.
3. Capped read-out valves.
4. Pre-formed insulation.
5. One differential pressure read-out meter for all valves in system.
6. 2 inches and smaller.

a. Brass body.
b. Threaded or soldered ends.
c. Teflon seats.
d. 250 pounds per square inch at 250 deg. F.

7. 2-1/2 inches and larger.

a. Ductile or cast-iron body.
b. Flanged.
c. 175 pounds per square inch at 250 deg. F.

8. Devices using venture type flow meter not acceptable (due to propensity for clogging and ease of putting valve with limited flow range in wrong direction).
9. Devices using Pitot tube or Annubar type flow meter not acceptable (due to propensity for clogging)
10. Devices using other than ball or butterfly valves shall not be used for coil isolation – a separate ball valve or butterfly valve shall be added for isolation (to ensure positive shut-off and to allow 90˚ open-close with memory stop).
11. Bell & Gossett type CB, or equal.

## 2.5 SAFETY AND RELIEF VALVES

A. Use "pressure relief valves" for unheated liquids.

B. Use "safety relief valves" for heated liquids.

C. ASME rated direct spring-loaded type.

1. Lever operated.
2. No- adjustable factory set discharge pressure.

D. Constructed, rated and stamped in accordance with ASME.

1. Relief valves: for unheated liquids.
2. Safety relief valves: for heated liquids.
3. Safety valves for gases and vapors: Including air and steam.

E. Set pressures and ratings.

1. Suitable and rated for system pressure and temperature: For safety relief valves, minimum temperature rating: saturated steam temperature corresponding to pressure 10 percent higher than valve set pressure.
2. Set pressure as indicated on Drawings: Not to exceed pressure rating of protected equipment.

F. Valves to open, under test, at set pressure with following tolerance.

1. Set pressure up to 70 pounds per square inch gage: plus or minus 2 pounds per square inch.
2. Set pressure, above 70 pounds per square inch gage: plus or minus 3 percent.

G. Capacities.

1. Valves shall have capacity to relieve maximum possible generated energy while maintaining pressure in protected equipment at no more than 10 percent above vessel working pressure.
2. Greater than make-up pressure reducing valve capacity.
3. Equipment relief valve capacity to exceed rating of connected equipment.
4. Provide multiple valves if required for capacity even though only one valve may be shown on Drawings.

H. Maintain pressure in protected equipment at not more than following.

1. Low pressure Boilers: 5 pounds per square inch above boiler working pressure.
2. High pressure Boilers: 6 percent above boiler working pressure.
3. Unfired Pressure Vessels: 10 percent above vessel working pressure.

I. Provide multiple valves if required for capacity even though only one valve may be shown on Drawings: Factory manifold.

J. Safety and Relief Valves: Similar to Consolidated.

K. Relief Valves, Water: Equal to Watts.

## 2.6 PRESSURE/TEMPERATURE TEST PLUG

A. Solid brass with valve core.

B. Valve core: Nordel.

C. Fitted with a color coded and marked cap with gasket.

D. Suitable for 500 pounds per square inch gage and 275°F for water systems.

E. Pete's Plug: No. 110/100XL with yellow cap or equal.

## 2.7 FLANGES

A. Convoluted.

B. Carbon steel, cold-formed.

C. Weld-neck and blind flanges in conformance with the design criteria of Section VIII, Division I of the ASME Pressure Valve Code.

D. Flanges drilled and tapped to match ANSI 150.

E. All material to comply with requirements of ASTM A516.

F. Gaskets: Teflon or as recommended by the flange manufacturer and suitable for the service.

G. Slip-on flanges will not be permitted.

H. 150-pound and 300-pound weld-neck and screwed steel flanges on steel lines to conform to ANSI Standard B16.5 for dimensions and ASTM A 181 Material Standard.

2.8 FLEXIBLE CONNECTORS

A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:

1. 2" and Smaller: Threaded.
2. 2-1/2", and Larger: Flanged.

B. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

C. Rubber, Flexible Connectors: CR or EPDM elastomer rubber construction, with multiple plies of NP fabric, molded and cured in hydraulic presses. Include 125-psig minimum working-pressure rating at 220 °F. Units may be straight or elbow type, unless otherwise indicated.

2.9 VENT COCKS

A. Bronze body, 1/4 inch size.

B. Lever handle.

C. 125 pounds per square inch steam working pressure.

D. Weiss LC-14 or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 STRAINERS

A. Wye-type: Where shown on drawings and ahead of all automatic flow control valves and pressure regulating valves.

B. Basket-type strainers: Where shown on drawings.

3.3 PRESSURE TEMPERATURE TEST PLUGS

A. Provide pressure/temperature test plugs, where shown on drawings.

B. Install at all equipment, coil, and heat exchanger connections. Install at each water source heat pump inlet and outlet.

C. Also locate at all temperature/pressure wells for calibration, see Section 230900 – Energy Management & Control Systems-General.

## 3.4 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 balancing valves at each branch connection to return main.

C. Install calibrated 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.

## 3.5 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 automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

## 3.6 INSPECTION

A. Verify that adequate clearance between piping specialties and adjacent walls or equipment is available to permit maintenance and repairs.

END OF SECTION

SECTION 23 31 13 - METAL DUCTS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:

1. Ductwork.
2. Plenums.
3. Fasteners, sealants, and gaskets.
4. Hangers and supports.

### 1.3 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ASHRAE - Handbook of Fundamentals; Duct Design.
2. ASHRAE - Handbook of HVAC Systems and Equipment; Duct Construction.
3. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
4. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
5. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
6. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
7. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
8. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.
9. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
10. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

11. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.
12. SMACNA – HVAC Duct Construction Standards.
13. SMACNA – Rectangular Industrial Duct Construction Standards.
14. SMACNA – Round Industrial Duct Construction Standards.
15. SMACNA – HVAC Air Duct Leakage Test Manual.
16. UL 181 - Factory-Made Air Ducts and Connectors.
17. Engineering Design Manual for Air Handling Systems, United McGill Corporation (UMC).
18. Assembly and Installation of Spiral Ducts and Fittings, UMC.
19. Engineering Report No. 132 (Spacing of Duct Hangers), UMC.
20. AWSD1.1 American Welding Society Structural Welding Code.

1.4 DEFINITIONS

A. Seam: locks or weld applied longitudinally to close section of duct, for example longitudinal seam, spiral seam.

B. Joint: abutting connection between duct sections for continuity of air passage, for example cross joint, transverse joint, coupling.

C. Reinforcement: hardware applied to strengthen duct, for example girth angles, tie rods, fasteners (not connectors), and the like.

D. Stiffening: folding, bending, beading, crossbreaking or corrugating of sheets to achieve strength through shape, for example pocket lock secures joint and is transverse stiffener, with girth angle and fasteners applied (not connectors), joint or stiffener is reinforced.

E. Duct Classification:

1. Pressure classification: except as indicated on the Drawings:

a. Low Pressure: Ductwork systems up to 2 inch w.g. positive or negative static pressure with velocities less than or equal to 1500 fpm.
b. Medium Pressure: Ductwork systems over 2 inch w.g. and up to 6 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.
c. High Pressure: Ductwork systems over 6 inch w.g. and up to 10 inch w.g. positive or negative static pressure with velocities greater than 2500 fpm.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements.

1. Entire ductwork system, including materials and installation, installed in accordance with NFPA 90A.
2. Ductwork and components shall be listed as U.L. 181, 181A and 181B, Class I air duct, flame rating not to exceed 25 and smoke rating not to exceed 50.

3. Flues shall conform to the requirements of NFPA-211. Products shall be listed to UL-103 and shall carry the appropriate UL listing mark or label.

B. Mockups:

1. Before installing duct systems, build mockups representing static-pressure classes in excess of 2inch wg. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

a. Five transverse joints.
b. One access door(s).
c. Two typical branch connections, each with at least one elbow.
d. Two typical flexible duct or flexible-connector connections for each duct and apparatus.
e. One 90-degree turn(s) with turning vanes.
f. One fire damper(s).
g. Perform leakage tests specified in "Field Quality Control" Article. Revise mockup construction and perform additional tests as required to achieve specified minimum acceptable results.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 SUBMITTALS

A. See Section 230010 Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop and coordination drawings according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

C. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Ductwork materials and fittings | R | | | R |
| Duct fasteners, sealants, and gaskets | R | | | |
| Flexible duct | R | | | R |
| Duct pressure testing reports | | R | | |

D. Mockups:

1. Before installing duct systems, build mockups representing static-pressure classes in excess of 3-inch wg. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

    a. Five transverse joints.
    b. One access door(s).
    c. Two typical branch connections, each with at least one elbow.
    d. Two typical flexible duct or flexible-connector connections for each duct and apparatus.
    e. One 90-degree turn(s) with turning vanes.
    f. One fire damper(s).
    g. Perform leakage tests specified in "Field Quality Control" Article. Revise mockup construction and perform additional tests as required to achieve specified minimum acceptable results.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Spiral oval and round ducts:

1. United Sheet Metal Division, United McGill.
2. Semco Manufacturing, Inc.
3. Eastern Sheetmetal.
4. Lindab, Inc.
5. Or equal.

C. Duct Connection Systems:

1. Ductmate Industries, Inc.
2. Fabriduct Transverse Duct Connection system.
3. Ward Industries, Inc.
4. Or equal.

D. Flexible Connections:

1. Ventfabrics.
2. Duro Dyne.
3. Or equal.

E. Flexible Ducts:

1. Thermaflex.
2. Hart & Cooley.
3. Flexmaster.

4. Or equal.

F. Duct Sealants:

1. Foster Products Corporation.
2. Hardcast Corporation.
3. 3M.
4. Or equal.

G. Flexible Duct Clamps:

1. Panduit.
2. Dura-Dyne.
3. Young Regulator Company.
4. Or equal.

H. Conical Tap Fittings:

1. Flexmaster.
2. Crown.
3. Die Stamp.
4. Or equal.

## 2.2 APPLICATIONS

A. Ductwork systems shall be constructed in accordance with the following Materials as a minimum standard. Refer to Drawings for any deviation from this Table.

| AIR SYSTEM | MATERIAL | SMACNA DUCT PRESSURE CLASS (1) | SMACNA DUCT SEAL CLASS(2) |
|---|---|---|---|
| Supply and Return Systems: | | | |
| Untreated Outside Air Intake (Louver) to AHU / Plenum | Galvanized Steel | -2″ w.g. | A |
| Single Zone FCU Supply | Galvanized Steel | 1″ w.g. | A |
| Single Zone AHU Supply | Galvanized Steel | 2″ w.g. | A |
| Return Air | Galvanized Steel | -1″ w.g. | A |
| Exhaust Systems: | | | |
| Exhaust Air Device to Exhaust Distribution | Galvanized Steel | -2″ w.g. | A |
| Exhaust Air Distribu-tion | Galvanized Steel | -2″ w.g. | A |

B. Table Notes:

1. Positive pressure unless noted otherwise in Table.

2. Seal Class A Sealing Requirements: Seal all transverse joints, longitudinal seams, and duct wall penetrations. Longitudinal seams are joints oriented in the direction of airflow. Transverse joints are connections of two duct sections oriented perpendicular to airflow. Duct wall penetrations are openings made by any screw fastener, pipe, rod or wire. Spiral lock seams in round and flat oval duct need not be sealed. All other connections are considered transverse joints, including but not limited to taps and other branch connections, access door frames and jambs, duct connections to equipment, etc.

## 2.3 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. (Minimum duct thickness shall be 24 gauge). Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Steel Sheet Metal:

1. Cold rolled soft steel sheets.
2. ASTM A653 and A924.
3. Galvanizing: 1-1/4 ounces per square foot, total both sides.

    a. General: G-90.
    b. Exposed to weather: G-90.
    c. Plenum walls and blank-offs where in contact with cooling coil: G-90.

4. Lock-forming quality.

C. Miscellaneous Products.

1. Screws and rivets:

    a. Same material as sheet, except as indicated on the Drawings.
    b. On aluminum sheets, provide cadmium plated or stainless steel.
    c. Zinc or cadmium plated, permitted on galvanized sheets.
    d. Minimum screw size: No. 10.
    e. Minimum rivet size: 4 pound.

2. Duct Sealants:

    a. Sealing compound: UL-181 listed, water based:

        1) Foster Safetee Duct Sealant 32-19.
        2) Childers CP-146.
        3) Hardcast Products Group Flex-Grip 550.
        4) Or equal.

    b. Rolled Elastomeric Duct Sealant: Hardcast Products Group Foil Grip 1403-181BFX, or equal, UL 181 listed.

c. Gaskets:

1) Continuous, reinforced, inert self-conforming type.
2) 1/8 inch thick.
3) Width: to match angle connection.
4) 3M Weatherban Ribbon Sealant PF5422 or equal.

d. Two-Part Hard-Setting Joint Tape:

1) Two-part process includes tape and hard setting sealant.
2) Mineral impregnated woven fiber tape.
3) Impregnated with activator/adhesive of polyvinyl acetate type.
4) UL Listed.
5) Flame spread: 10.
6) Smoke contributed: 0.
7) Equal to Hardcast RTA-50 sealant and DT-5400 4 inch tape.

3. Spring Fasteners:

a. Oval head stud and receptacle.
b. Screwdriver slot.
c. Self-ejecting.
d. Dzus or equal.

4. Angles, tie rod and shapes for reinforcing ducts: In accordance with SMACNA HVAC Duct Construction Standards, except as indicated on the Drawings.
5. Duct connection system:

a. Transverse bolted duct joints.
b. Flanges with permanent, non-hardening sealant.
c. Ductmate Industries Ductmate 25 and 35, Fabriduct TDC, or equal.

D. Flexible Connections:

1. Conforming to NFPA 701, UL Standard No. 214 and NFPA 90A.
2. SMACNA HVAC Duct Construction Standards, except as indicated on the Drawings.
3. With metal edges at each end: No. 24 USSG galvanized steel. Double lock joint.
4. Length of fabric connections.

a. Minimum: 4 inch.
b. Maximum: 10 inch.

5. Materials:

a. Coated glass fabric.
b. Flame spread rating: 25.
c. Smoke development rating: 50.
d. 30 ounces per square yard.
e. Sewed and cemented seams.
f. Indoors:

1) Neoprene.
2) Ventfabrics, Inc. Ventglas or equal.

E. Turning Vanes:

1. Galvanized steel ductwork: galvanized steel or painted black steel, except as indicated on the Drawings.
2. Other ductwork: same material as ductwork.
3. Construction per SMACNA HVAC Duct Construction Standards for:

a. Single wall vanes with ¾ inch trailing edge.
b. Double wall vanes: Not acceptable.
c. Vane length: Provide separate equal size sections for vane length greater than those indicated in referenced Standards.
d. Vane runners: Type 1 or 2 acceptable.

4. Vane radius:

a. 2 inch radius: duct width up to 36 inches.
b. 4-1/2 inch radius: duct with 36 inches or larger.

5. Vane shall be at the correct angle for airflow (leading edge in line with the entering duct section, leaving edge in line with existing duct section). If only 45° angles are available, turning vanes shall only be used in 90° elbows where the entering width equals the exiting width; all other elbows shall be full radius type unless otherwise indicated on the drawings.

F. Conical Taps: Low-pressure round take-off fittings in rectangular duct:

1. Heavy 26-gauge G-90 Galvanized Steel Body
2. (1") 26-gauge G-90 Galvanized Steel Flange
3. Double Sided Adhesive Gasket on Flange
4. Extra Heavy 24-gauge G-90 Galvanized Steel Blade
5. 3/8" Square Axle Secured to Blade with U-bolts (2 U-bolts used for 8" diameter and larger)
6. Nylon bushings on thru and end (all sizes)
7. 2" Stool with Locking Quadrant and Handle (all sizes, wing nuts not acceptable)
8. Sealed on all Seams
9. BO3 (2") Build-out, 3/8" Square Shaft (solid rod), U-bolt, Locking Quadrant, Handle
10. Flexmaster CBD-SOG-BO3 UT 3000G, Crown 3210-DS2 or equal.

## 2.4 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS (LOW PRESSURE)

A. Duct Classification: Ducts shall be considered low pressure when design velocities are 1800 fpm or less and maximum static pressure is 2-inch W.G., positive or negative.

B. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized sheet metal, according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible." Comply with requirements for metal thickness, reinforcing

types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
2. Materials: free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inches thick or less, with more than 10 square feet of unbraced panel area, unless ducts are lined.

D. 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."

E. 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."

F. 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."

## 2.5 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS (LOW PRESSURE)

A. Duct Classification: Ducts shall be considered low pressure when design velocities are 1800 fpm or less and maximum static pressure is 2-inch W.G., positive or negative.

B. 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.

C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

D. Factory-fabricated spiral lock seam duct:

1. Snap-lock is not acceptable.
2. Factory-fabricated longitudinal seam acceptable for ducts larger than standard factory sizes.

3. Round Duct Flanges: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances. All flanges to be factory mounted.
4. Flat Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

E. Fittings:

1. Same material, gauge thickness and construction as duct in which installed.

2. Full body fittings are acceptable.

3. Elbows:

a. Seams:

1) 4 inch and higher pressure, class and all ducts exposed to occupant view: continuously welded seams.
2) 1 inch to 3 inch pressure: spot welded with bonded (sealed) seams.

b. Gores:

1) 2 gores - less than or equal to 30 degrees.
2) 3 gores - 31 degrees through 45 degrees.
3) 4 gores – 46 degrees through 60 degrees.
4) 5 gores - over 61 degrees

| Type | Pressure | Location | Fittings | Traverse Joints | Branches | Couplings |
|---|---|---|---|---|---|---|
| Round | < 2″ | Concealed | Factory Fabricated | Conical/ 45° Entry | Loose Saddle Tap Field Installed | Slip ≤ 20″ Flanges > 20″ |
| | < 2″ | Exposed | Factory Fabricated | Conical/ 45° Entry | Factory Installed | Slip ≤ 20″ Flanges > 20″ |
| Oval | < 2″ | Concealed | Factory Fabricated | Conical/ 45° Entry | Factory Installed | Slip ≤ 20″ Flanges > 20″ |
| | < 2″ | Exposed | Factory Fabricated | Conical/ 45° Entry | Factory Installed | Slip ≤ 20″ Flanges > 20″ |

## 2.6 FLEXIBLE DUCTS

A. General Requirements:

1. Flexible ducts shall be used for supply air ducts only (not acceptable for return, exhaust, relief, outdoor, etc. air ducts).
2. UL 181, Class I Air Duct.
3. Labeled for compliance with IMC.
4. Class 1 Air Duct, NFPA 90A and 90B, BOCA, SBBC, HUD/FHA, MIN Property Std.

B. Type 1 Acoustical Insulated

1. Minimum working pressure:

   a. 10” w.g. positive
   b. 5” w.g. negative, 16” diameter
   c. 1” w.g. negative, 18” & 20” diameter

2. Rated Velocity

   a. 5,550 fpm

3. Acoustic Performance:

   a. Minimum insertion loss (dB) for 6’ of 8” diameter flexible duct for flow velocities less than 2,500 fpm.
   b. Acoustical testing to be performed in accordance with ASTM E477 and ADC Test Code FD 72-RI by ETL

| | *Sound Power Levels, dB re. $10^{-12}$ Watts, at Octave Band Center Frequency, Hz* | | | | | |
|---|---|---|---|---|---|---|
| | *125* | *250* | *500* | *1000* | *2000* | *4000* |
| *Insertion Loss* | *5* | *16* | *17* | *18* | *16* | *11* |

4. Duct Fabric:

   a. Polyethylene fabric. Fabric to be mechanically locked to the duct helix without the use of adhesives

5. Duct Helix

   a. Corrosive resistant galvanized steel. Helix is to be mechanically formed to attach the duct fabric without the use of adhesives.

6. Vapor Barrier

   a. Fire retardant, reinforced aluminum.
   b. (.05) perm A.S.T.M. E96, Procedure A

7. Insulation

   a. Factory insulation jacket, factory wrapped. R8 minimum.

8. Flexmaster Type 1M or equal.

C. Type 6 Acoustical Insulated (in locations as indicated on schedules/plans)

1. Minimum working pressure:

   a. 6” w.g. positive
   b. 5” w.g. negative, 16” diameter
   c. 1” w.g. negative, 18” & 20” diameter

2. Rated Velocity

   a. 5,550 fpm

3. Acoustic Performance:

   a. Minimum insertion loss (dB) for 6’ of 8” diameter flexible duct for flow velocities less than 2,500 fpm.
   b. Acoustical testing to be performed in accordance with ASTM E477 and ADC Test Code FD 72-RI by ETL

| | *Sound Power Levels, dB re. $10^{-12}$ Watts, at Octave Band Center Frequency, Hz* | | | | | | |
|---|---|---|---|---|---|---|---|
| | *63* | *125* | *250* | *500* | *1000* | *2000* | *4000* |
| *Insertion Loss* | *5.7* | *14* | *13* | *15* | *16* | *18* | *16* |

4. Duct Fabric:

   a. Spunbond Nylon fabric. Fabric to be mechanically locked to the duct helix without the use of adhesives

5. Duct Helix

   a. Corrosive resistant galvanized steel. Helix is to be mechanically formed to attach the duct fabric without the use of adhesives.

6. Vapor Barrier

   a. Fire retardant, reinforced aluminum.
   b. (.05) perm A.S.T.M. E96, Procedure A

7. Insulation

   a. Factory insulation jacket, factory wrapped. R8 minimum.

8. Flexmaster Type 6M or equal.

## 2.7 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

### 3.1 INSTALLATION

A. Coordinate with work of other trades.

B. Ductwork Installation – General:

1. Install ducts in accordance with manufacturer’s written installation instructions.
2. 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.
3. Construct with gages, joints, bracing, reinforcing, and other details per latest IMC, ASHRAE, SMACNA and NFPA, unless specified otherwise.

    a. Comply with most stringent.
    b. Provide ducts with IMC gages or thicker when traversing rated corridors.
    c. Combustion air ducts: Minimum 24 gage.

4. Construct of galvanized sheet metal, except where otherwise indicated herein or on Drawings.
5. Provide for duct rigidity by either of these methods:

    a. Beading at 12 inches on center, maximum.
    b. Cross-break outward in ducts having positive internal pressure.
    c. Cross-break inward in ducts having negative internal pressure.

        1) Exception: All ducts exposed to rain shall outward cross-break on top of the duct.
6. Duct dimensions indicated are outside duct dimensions (OD) unless indicated on the Drawings as inside dimension (ID or net, clear dimension).
7. Alter duct sizes on basis of equal friction where required to facilitate installation. Reflect changes in shop drawings for review by Architect.
8. At duct penetrations of walls, floors and ceilings where exposed to occupant view, provide sheet metal angle type escutcheons with no sharp corners or edges.

    a. Clearance from duct to opening shall not exceed 2 inches.
    b. Escutcheons shall overlap wall, floor, or ceiling surface by ½ inch minimum.

9. Frame, trim, caulk and seal all duct penetrations through acoustical walls and partitions.
10. Tapers:

    a. Pitch sides of duct in diverging or converging airflow maximum of 1 to 4 taper.
    b. Abrupt, bushing type fitting not allowed.

11. Duct Openings:

    a. Provide openings where required to accommodate thermometers, smoke detectors, controllers, and the like. Insert through airtight rubber grommets.
    b. Where openings are provided in insulated ductwork for insertion of instruments, install insulation material inside metal ring for use as plug.
    c. At fire dampers allow adequate length of duct to install access door.

12. Avoid penetration of ducts; provide airtight seal at unavoidable penetrations of hanger rods.
13. No exposed sharp metal allowed.

    a. All exposed pins, screws and sharp objects shall be covered with hardening silicon.
    b. All exposed sheet metal edges shall be hemmed with exposed corners rounded smooth.
    c. Remove all sheet metal fish hooks.

14. Install lining in ducts and plenums as specified in Section 230719 – Piping and Equipment Insulation.
15. Flexible Connections:

    a. Coated glass fabric.
    b. For indoor or outdoor use.
    c. Use diaphragm type at plug fan inlets.
    d. Install at connections to fans and air handling units and as indicated on Drawings.
    e. 2 inch slack in fabric; install to allow minimum movement of 1 inch in both tension and compression.
    f. Protect from direct solar and rain exposure with sheet metal shroud where outdoors.

16. Volume dampers: Install dampers as specified in Section 233300 – Air Duct Accessories

C. Elbows and Splits:

1. Use radius elbows in rectangular ducts unless otherwise indicated on the Drawings: Centerline radius dimension shall not be less than 1-1/2 duct width.
2. Where space does not permit duct radius specified above, install short radius splitter vanes per SMACNA HVAC Duct Construction Standard.

    a. Number of vanes determined by ratio of inner radius (R) to duct width in plane of radius (W).
    b. One vane: Radius to width ratio above 0.3.
    c. Two vanes: Radius to width ratio between 0.1 to 0.3
    d. Three vanes: Radius to width ratio 0.1 and smaller.

3. Use square turns with turning vanes in rectangular ductwork, unless otherwise indicated on the Drawings, at following locations.

    a. Use only where full radius elbow cannot fit.
    b. Use only in ducts with 2000 fpm or less design velocity.
    c. In high and medium pressure ductwork spot weld turning vane to duct.

D. Rectangular Duct Joints:

1. Transverse Joints:

    a. In medium pressure ductwork shall be Fabriduct TDC or Ductmate or equal.
    b. In low pressure ductwork shall be Fabriduct TDC or equal except that ducts under 19 inches longest side may be slip & drive (S&D)

2. Longitudinal seams shall be Pittsburgh. Snap lock not allowed.

E. Plenum walls, blank-offs, and casings:

1. Construct per SMACNA HVAC Duct Construction Standard, Casings and Plenums.
2. Static pressure class:

    a. Upstream of fan: -2 inches.
    b. Downstream of fan: fan static pressure or greater.

3. Seal all joints, edges, and penetrations as per HVAC ducts as specified herein.

F. Round and oval ductwork:

1. Joints between ducts:

    a. Made with beaded sleeve joints as scheduled.
    b. Duct sealer applied to male end.
    c. Mechanically fastened with sheet metal screws or pop rivets.
    d. Over joint and screw or rivet heads, apply coating of duct sealer.

        1) Duct where exposed to occupant view: Sealant shall be within joint only and not visible.

2. Joints, duct and fitting:

    a. Slip projecting collar of fittings into duct: Per SMACNA HVAC Duct Construction Standard.
    b. Apply duct sealer: Seal and tape as specified above.
    c. Mechanically fasten: Fastening schedule: Per SMACNA HVAC Duct Construction Standard.

3. Branch take-offs:

    a. Medium pressure: 45 degrees (fittings).
    b. Low pressure: straight 90 degrees (fittings).

4. Horizontal supports:

    a. One or two-piece clamp band strap.
    b. Minimum: one per section.
    c. Support fittings as required to prevent sagging.

5. Vertical Supports: one of the following:

    a. Clamp bands with extended ends supported by floor.
    b. Clamp bands with knee bracing.
    c. Pedestal at base of vertical.

G. Flexible ductwork:

1. Not allowed for:

    a. Return, exhaust, or outdoor air ducts.
    b. Product conveying systems such as kitchen exhaust and laboratory exhaust.
    c. Dryer exhaust (other than final exposed connection at dryer).

d. Medium and high pressure, ducts.

2. Continuous, single pieces:
3. Length:

a. Low pressure:

1) Maximum 5 feet, except where longer lengths are indicated on drawings. Where longer lengths are shown, the last 3 feet to 5 feet shall be wire flex duct and remaining ductwork shall be aluminum flex duct.
2) Minimum length: 3 feet.

4. End connections:

a. Connect to duct collars, terminal unit connections and round air outlets per manufacturer's instructions.
b. Secure with strap clamps specified above.

5. Installations:

a. Support adequately to avoid excessive droop.
b. Minimum inside bending radius not less than one duct diameter.
c. Install as straight as possible except as shown on drawings for sound attenuation.
d. Cut ducts to lengths required rather than create bends to take up excess lengths except as shown on drawings for sound attenuation.

H. Grille connections:

1. Provide at entry to diffuser collar either.

a. Straight duct for 1 duct diameters or greater.
b. Full radius elbow.
c. Side inlet plenum.

1) Height: 4 inches minimum taller than top of grille to provide room for uniform airflow to grille.
2) Width/length: 2 inches wider than duct or round diffuser collar, whichever is larger.
3) Internal surfaces lined with minimum 1/2 inch thick Type AL duct liner as specified under Section 230719 – Piping and Equipment Insulation.
4) At contractor’s option, where plenum is required at round neck diffuser, square neck diffuser with length and width equal to diffuser diameter may be substituted.

d. Thermaflex FlexFlow Elbow or equal.

2. Connections at grilles shall be insulated to the extent the duct is insulated including the final register box.
3. Seal connections at grilles per seal class of upstream ductwork.

I. Sound-rated duct packing:

1. Wherever possible avoid duct penetrations through sound-rated walls, floors and ceilings.
2. Provide packing for unavoidable duct penetrations.

## 3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Ductwork exposed to occupant view shall be run straight and true, in line with building elements. No sagging or out-of-true straight runs shall be acceptable. Sidewall taps, and duct joints shall be clean and free of visual blemishes and all sealant shall be internal to joint and not visible. Ducts shall have no external markings or tags. All duct beads shall be parallel.

C. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

D. 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.

E. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

F. Repair or replace damaged sections and finished work that does not comply with these requirements.

## 3.3 DUCT SEALING

A. Ducts not exposed to weather: Seal using one of the following:

1. Duct sealer compound.
2. Gasketed TDC or Duct-Mate.
3. Two-Part Hard-Setting Joint Tape.
4. Flexible duct:

    a. Secure with straps or clamps as specified herein.
    b. Supplement with duct tape, both inner and outer liner.

5. Indoor duct where exposed to occupant view: Sealant shall be within joint only and not visible.
6. Fire and fire/smoke dampers: Sealant shall be listed as approved on manufacturer’s UL installation sheet.
7. Continuously welded ducts: Additional sealing not required.

B. Seal punched holes and corner cracks.

C. Seal all factory fabricated ducts, including transverse joints on gored elbows.

D. Seal end caps.

E. After installation and testing reseal joints found to be leaking at no additional cost to the Owner.

## 3.4 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.

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 intervals 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.

## 3.5 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.

## 3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

3.7 DUCT AIR LEAKAGE TESTING

A. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test. See the Duct Air Leakage Test Log at the end of this section.
2. Test the following systems:

    a. Supply, Return, Exhaust, and Outdoor Air Ducts: Test 100% of installed duct sections.
    b. Field installed plenums. Test 100% of all field installed plenums.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

B. General:

1. Pretesting shall be conducted prior to conducting test in presence of TAB Agency and Architect. Once all required ductwork has passed the pretest duct pressure test, the TAB Agency and Architect shall be notified to visit the site for witness testing.
2. Use portable high pressure, blower and necessary instruments to indicate amount of leakage.
3. Conduct tests as prescribed in SMACNA HVAC Air Duct Leakage Test Manual and make test before duct sections are concealed.
4. Procedure:

    a. Seal openings in ducts and plenums to be tested.
    b. Connect test apparatus to test section using flexible duct connection or hose.
    c. Close damper on blower suction side, to prevent excessive buildup of pressure.
    d. Start blower and gradually open damper on suction side of blower.
    e. Build up pressure in test section equal to static pressure class.
    f. Noise generated from duct leakage not acceptable. Seal as required.
    g. Determine amount of air leakage by makeup air flow measurements:

        1) Maximum permitted leakage for HVAC ductwork shall be:

$$CFM_{max} = \left(\frac{A}{100}\right) C_L P^{0.65}$$

Where,

$CFM_{max}$ = The maximum permitted leakage, cubic feet per minute (cfm).

A= Surface area of the tested duct sections, square feet.

$C_L$= Duct leakage class, cfm/100 square feet at 1 inch water column.

= 6 for rectangular sheet metal, rectangular fibrous ducts, and round flexible ducts

= 3 for round/flat oval sheet metal or fibrous glass ducts

P= Test pressure which shall be equal to the design duct pressure class rating, inches water column.

2) Allowable leakage can also be calculated as 1 percent of the design operating air volume for the entire system. If this method is used, the total system leakage must first be determined and then compared with the 1 percent (of system volume flow) allowable leakage. Acceptance is indicated if the actual measured leakage of the entire system is less than the calculated allowable leakage.

3) If leakage exceeds permitted limit, repair leaks and retest duct sections at no additional cost to the Owner until permitted leakage limits are obtained.

5. Visually mark tested sections with certification sticker and initials of field test inspector.

C. Documentation:

1. Submit certification of test results of compliance to Architect (must be initialed by TAB Agency representative prior to submitting to Architect).
2. Include Duct Air Leakage Test Log indicating compliance.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and test logs.

## 3.8 PROTECTION

A. Adhere to SMACNA Duct Cleanliness for New Construction Guidelines for Intermediate Level Duct Cleanliness unless more stringent requirements are indicated herein.

B. Storage: Porous materials, such as lined and flexible duct, shall be stored where they will not be exposed to rain or other moisture sources.

C. Temporary closure: Provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris at the following conditions:

1. Exposed ends of unlined installed ducts at the end of each day.
2. Exposed ends of lined ducts or plenums whether in storage or installed.

D. Duct cleaning:

1. Using the connected fan(s) force air at high velocity through duct to remove accumulated dust.
2. Protect equipment and spaces, which may be harmed by excessive dirt with filters, or bypass during cleaning.
3. In areas, which must be kept dust free, seal all outlets duct tight. When closures are removed avoid spilling dust in room.

## 3.9 INSPECTION

A. Verify that adequate clearance between ducts and adjacent walls or equipment is available to permit proper sealing, maintenance and repairs.

## 3.10 PRE-OPERATING CHECKS

A. Before operating the duct systems: Set all manual dampers in full open position.

## 3.11 TESTING AND ADJUSTING

A. After starting the duct systems: Check for noise and leakage. Repair as required at no additional cost to the Owner.

B. See Section 230593 – Testing, Adjusting, and Balancing for HVAC: Coordination with Balance Agency:

1. Provide services of a sheet metal installer familiar with the system ductwork to provide assistance to the balancing agency during the initial phases of air balancing in locating all sheet metal dampers.
2. Install missing dampers.

| Duct Air Leakage Test Log | | | | | |
|---|---|---|---|---|---|
| Date | System | Description of Duct Section Tested | Test Press. (in w.g.) | Results Pass/ Fail | Witness (TAB Agency) Initials |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

END OF SECTION

SECTION 23 33 00 - AIR DUCT ACCESSORIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:

1. Access Doors.
2. Balancing Dampers.
3. Fire dampers.
4. Drain Pans.
5. Condensate Pumps.
6. All duct accessories except, where integral with manufactured piece of equipment.

### 1.3 QUALITY ASSURANCE

A. Fire dampers shall be UL listed and constructed in accordance with UL Standard 555 Fire Dampers and UL Standard 555S.

B. Demonstrate operation of fire dampers to authorities having jurisdiction and Architect as part of life safety testing.

C. Access doors shall be UL labeled.

D. Damper pressure drop and leakage ratings shall be based on tests and procedures performed in accordance with AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

### 1.4 SUBMITTALS

A. See Section 230010 Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop and coordination drawings according to the following table.

1. “R” means required.
2. “R2” means required only for products and equipment differing for the specified manufacturer and model and for “or equals” where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Access doors | R2 | | | R |
| Balancing dampers | R2 | | | R |
| Fire dampers | R | R | | R |
| Drain pans | R2 | | | R |
| Condensate pumps | R | R | | |
| Belt guards | R2 | | | |

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Access Doors, Ducts.

1. Ventfabrics, Inc.
2. Duo Dyne, Corporation
3. Ruskin Mfg. Company
4. PCI Industries – Pottorff
5. Ductmate

C. Access Doors, Plenum.

1. Ventfabrics, Inc.
2. Duo Dyne, Corporation.
3. Elgen Manufacturing Company.

D. Balancing Dampers.

1. Ruskin Manufacturing Company.
2. Greenheck Fan Corp.
3. PCI Industries - Pottorff
4. Johnson Controls.

E. Damper Hardware.

1. Ventfabrics, Inc.
2. Duo Dyne, Corporation.
3. Young Regulator Company.

F. Fire Dampers.

1. Ruskin Manufacturing Company.
2. Greenheck Fan Corp.
3. Air Balance Inc.
4. PCI Industries – Pottorff.

## 2.2 DUCT ACCESS DOORS

A. In accordance with SMACNA Duct Construction Manuals, except as indicated in the Drawings.

B. Construction:

1. Galvanized steel.
2. Rating same as duct pressure class.
3. Where duct is insulated:

    a. Fiberglass insulation, thickness to match duct insulation installed R-value, see 230719 – Piping and Equipment Insulation.
    b. Double wall.

4. Removable type with safety chain linking door permanently to frame.
5. Positive seal polyethylene gasket.
6. Paired progressive cam-locks, quantity as required for tight, low leakage fit.
7. No tools required for opening and closing.

C. Size:

1. 20 inches x 14 inches unless otherwise indicated in the Drawings.
2. Ducts less than 16 inches: one dimension 20 inches; other dimension 2 inch less than duct width.
3. Larger sizes where required for access.

D. Provide in the following locations:

1. Coils in ducts (including at VAV boxes).

    a. Entering and leaving side for cooling coils.
    b. Entering side for heating coils.

2. Automatic dampers: linkage side.
3. Fire dampers.
4. At the top of each lined duct riser accessible from the fan room floor (for inspection of duct liner).
5. Fan bearings enclosed in ducts.
6. Sprinkler heads in ducts.
7. Motors, actuators or other accessories that require access or service inside ducts.
8. Outdoor air plenums as required to clean plenum from dirt and debris.
9. Where otherwise indicated on the Drawings.

## 2.3 MANUAL DAMPERS

A. Manual Dampers:

1. Conform to requirements of SMACNA HVAC Duct Construction Standards.

2. General:

   a. Blades of same material as duct where damper is located.
   b. Damper Hardware:

      1) Ventlok 400 and 4000 series or equal; for low pressure systems 2 inch SMACNA pressure class and less.
      2) Ventlok HiVel hardware or equal; for greater than 2 inch SMACNA pressure class.

   c. Actuating quadrants typical for single and multi-blade dampers; provide closed bearing on opposite end from quadrant to prevent air leakage: Ventlok No. 609 or equal.
   d. Bearing at one end of damper rod: Ventlok No. 609 or equal.
   e. Sealed bushings installed at both ends to avoid duct leakage.
   f. Accessible quadrant at other end of damper rod.

      1) With lever and lock screw: Ventlok No. 635 or equal.
      2) Insulated ducts.

         a) Quadrants mounted on collar to clear insulation.
         b) Ventlok Nos. 637, 638, or 639 or equal.
         c) Selection based on insulation thickness.

   g. For dampers above non-removable ceilings and without ceiling access panels provide Ventlok No. 677 or equal concealed damper regulator.

      1) With paintable cover plate.
      2) Required interconnecting hardware.

3. Single blade dampers:

   a. Galvanized steel ductwork: galvanized steel, except as indicated in the Drawings.
   b. Blade: Two gauges heavier than duct gauge, or 18 gauge, whichever is lighter.

4. Multi-blade dampers.

   a. Low Pressure/Low Velocity Systems (2 inch water column or less static pressure class and 1500 fpm or less face velocity).

      1) Opposed blade damper.
      2) Ruskin Model CD35 or equal.

   b. High Pressure/High Velocity Systems (greater than 2 inch water column static pressure class or greater than 1500 fpm face velocity):

      1) Rectangular.

         a) Opposed blade damper.
         b) Ruskin Model CD60 or equal.

2) Round and Oval.

a) Oval: Ruskin Model CDR25 and DO25 or equal.
b) Round: Up to 20 inch diameter: Ruskin Model MDRS25 or equal.
c) Round: Larger than 20 inch diameter: Ruskin Model CDRS25 or equal.

## 2.4 FIRE DAMPERS

A. Ratings (test conditions and label) per UL Standard 555.

1. 250 degrees Fahrenheit minimum.
2. 1-1/2 hour fire rating, unless otherwise indicated in the Drawings.
3. Dynamic (closes against air flow).

B. Factory sleeve.

C. Damper.

1. Multi-bladed, equipped with fusible link, spring loaded type.
2. Style:

a. As indicated on the Drawings.
b. Ducted, rectangular duct: Style B (out of airstream).
c. Ducted, round duct: Style A (in airstream) with damper sleeve 2” in each dimension larger than duct; plus cap and collar.
d. Unducted: Style A (in airstream).

D. Fusible Link.

1. UL listed.
2. Fusible links on fire dampers shall be constructed to UL Standard 33 – Fusible Links for Fire Protection Service.
3. Temperature rating: Per code.

E. Type:

1. Rectangular type up to 1000 feet per minute: Ruskin DIBD2 or DIBD10 Style A or equal.
2. Rectangular type 1000 feet per minute and higher: Ruskin DIBD2 or DIBD10 Style B or equal.
3. Circular and oval type: Ruskin DIBD2 Style CR and CO, or DIBD10 Style R and LO or equal.

F. Status end switches:

1. Where indicated on the Drawings.
2. Ruskin SP100 or equal Switch Package.

2.5 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.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Compliance with ASHRAE/IESNA 90.1-2010 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Volume dampers.

1. 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.

    a. Volume dampers shall be installed as far away from air outlets as functionally reasonable to avoid noise in the occupied space.
    b. Provide also in wyes and branch take-offs to outlets whether indicated on the Drawings or not, except.

        1) To sidewall outlets in exposed ducts (opposed blade dampers in outlets shall be provided).

2. For ductwork exposed to occupant view, volume damper handles shall be on top of duct or otherwise concealed from occupant view.

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. Fire dampers.

1. Provide in ducts and openings as indicated in the Drawings.
2. Provide access door in duct adjacent to each in location where damper may be inspected, and internal fusible link or fire-stat may be replaced.

H. Drain pans.

1. See Section 221316 – Sanitary Waste and Vent Piping.
2. Auxiliary drain pans.

a. See Section 221316 – Sanitary Waste and Vent Piping.
b. Separate drain from main drain pan.
c. Discharge where water flow is readily observed but not over any material or equipment that may be damaged by water.

I. Connect ducts to duct silencers rigidly.

J. 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 dampers, to reset or reinstall fusible links. Access doors for access to fire 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.

K. Install access doors with swing against duct static pressure.

L. Label access doors according to Section 230553 Mechanical Identification to indicate the purpose of access door.

M. Install duct test holes where required for testing and balancing purposes.

## 3.2 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 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.
5. Operate remote damper operators to verify full range of movement of operator and damper.

## 3.3 TESTING AND ADJUSTING

A. After starting duct accessories.

1. Check for noise and leakage; repair as required at no additional cost to the Owner.
2. Operation test: Test each piece of equipment to show that it will operate in accordance with requirements.

B. See Section 230593 – Testing, Adjusting, and Balancing for HVAC

END OF SECTION

SECTION 23 37 00 - AIR OUTLETS AND INLETS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes, and authorities having jurisdiction for the following: All air outlets, inlets, grilles, registers, and diffusers except where integral with manufactured piece of equipment

### 1.3 REFERENCE STANDARDS

A. ARI Standard 650 – Air Outlets and Inlets.

B. ASHRAE Standard 70 – Methods of Testing for Rating the Airflow Performance of Outlets and Inlets.

C. AMCA Standard 500 – Laboratory Methods of Testing dampers for Rating.

D. NFPA Standard 90A – Installation of Air Conditioning and Ventilating Systems.

E. NFPA 90B – Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

### 1.4 QUALITY ASSURANCE

A. Comply with ARI Standard 650, ASHRAE Standard 70, AMCA Standard 500, NFPA Standard 90A, and NFPA Standard 90B.

B. Provide outlets and inlets that have, as minimum, throw and noise criteria ratings for each size device as listed in manufacturer's current data, rated as required by the above standards.

### 1.5 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Grilles, registers, and diffusers | R | | | R |
| Accessories | R | | | |

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

1. Titus.
2. Price.
3. Metal Aire.
4. Nailor.
5. Or equal.

### 2.2 AIR DISTRIBUTION DEVICES

A. Manufacturer shall examine and approve of application of each outlet.

B. Noise level at design capacities: no larger than diffuser selection indicated on the drawings.

C. Material:

1. All grilles are to be of steel construction unless otherwise indicated on schedules.

D. Volume dampers:

1. Do not provide dampers built into grille or directly attached to the grille unless specifically called out on drawings.
2. Opposed blade volume damper key-operated adjustable from face of diffuser on register except as noted.

E. Diffuser frame:

1. Frame type shall be coordinated with ceiling type. Refer to architectural reflected ceiling drawings.

a. At plaster or drywall ceilings:

1) Lay-in diffuser with drywall frame (Titus TRM to match diffuser material). Drywall frame to match diffuser color.

2. No visible screw allowed on diffusers or frames, unless otherwise indicated on the Drawings.
3. Linear and bar diffusers shown as one collinear piece on plans shall be constructed as one piece within manufacturing limitations and to appear as one section if manufacturing limitations require multiple pieces. Provide with Border Type shown on plans. Coordinate exact border type with design professional before ordering.

F. Color:

1. Face and frame: Factory-baked #26 white enamel unless otherwise indicated on the Drawings.
2. Internal parts of grille visible from occupied space, including all parts behind perforated face diffusers and visible parts of plenums: flat black.

G. Provide square to round adapters where required.

H. Provide one-, two-, three- or four-way discharge patterns as indicated on plans.

I. See Construction Drawings for basis of design air outlets and inlets types, and sizes.

## 2.3 SCREENED OPENINGS

A. Mesh:

1. 3/4 in. square pattern.
2. No. 16 galvanized wire.
3. Interwoven.
4. Welded or secured to frame.

B. Frames:

1. 1 inch by 1 inch by 1/8 inch galvanized steel angles.
2. Continuous around perimeter of screen (welded at corners).

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Coordinate with work of other trades.

B. Install air outlets and inlets in accordance with manufacturer's written installation instructions and Section 233113 – Metal Ducts.

C. Return and exhaust registers: Install with blades oriented to prevent sight through outlets.

D. Grille backs or plenums visible through grilles painted flat black.

E. Transfer grilles.

1. See indications on the Drawings.
2. Wall installations, unless otherwise indicated, provide two grilles.

a. One on each side of wall, except where open to return air plenum.
b. Connecting sheet metal collar with 18 inch elevation offset for sound and light attenuation.

F. Provide duct screens at termination ducts as indicated on the Drawings.

## 3.2 MOUNTING AND ALIGNMENT

A. All air outlets and inlets shall be secured to building.

1. Ceiling grilles shall be secured to prevent falling from ceiling during construction or service with minimum of two 16-gage ceiling wires, two 22-gage by 1 inch galvanized sheet metal strap or two #10 sheet metal screws.
2. Comply with IBC.

B. Mount directional grilles as indicated on the Drawings.

C. Adjust grille throw patterns.

1. As indicated on the Drawings.
2. For double-deflection grilles, adjust rear blades horizontal and front blades in 45 degree pattern at each end gradually rotating to be almost straight at blades in center of grille.
3. Adjust grille throw patterns prior to test and balance. See Section 230593 – Testing, Adjusting, and Balancing for HVAC.

## 3.3 INSPECTION

A. Verify mounting, direction and adjustments are installed as indicated on the Drawings.

## 3.4 TESTING AND ADJUSTING

A. See Section 230593 – Testing, Adjusting, and Balancing for HVAC.

END OF SECTION

SECTION 23 40 00 - AIR CLEANING DEVICES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Work included in this section: materials, equipment, fabrication, installation, and tests in conformity with applicable codes and authorities having jurisdiction for the following:

1. Filter media.

### 1.3 REFERENCE STANDARDS

A. ASHRAE Standard 52.2-1999 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

B. ANSI/UL 900 – Test Performance of Air Filter Units.

### 1.4 QUALITY ASSURANCE

A. Filters shall have MERV ratings in accordance with ASHRAE Standard 52.2 with preconditioning as specified in Appendix J of that Standard.

### 1.5 SUBMITTALS

A. See Section 230010 – Mechanical General Provisions

B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Filters | R | | | |

## PART 2 - PRODUCTS

### 2.1 MANUFACTUERERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

B. Filter Media and Frames:

1. Camfil/Farr Filtration Group.
2. Flanders/Precisionaire.
3. American Air Filter.
4. Or equal.

### 2.2 FILTERS

A. General.

1. UL 900 listed.
2. Disposable type.
3. Each filter shall consist of media, media support grid, and enclosing frame.
4. Each filter shall have flow direction and MERV rating permanently affixed to frame.

B. Type 1: Pleated Filter:

1. 2 inch or 4 inch pleated (verify with submitted and approved equipment).
2. Media: Cotton & synthetic media (no polyester).
3. Minimum performance:

    a. MERV 8.

4. Maximum initial pressure drop at 500 feet per minute face velocity shall not to exceed 0.3 inches water column. Final pressure drop shall be no less than 1.0 inch water column.
5. Camfil/Farr 30/30 or equal.

C. Type 2: Bulk Media:

1. 1 inch fiberglass.
2. Filter media shall consist of a continuous filament fiberglass of graduated density. Media shall include a skin on the leaving air side. Furthermore, the media shall be treated with a non-toxic, non-flammable, odor free adhesive.
3. UL listed, Class 2.

## PART 3 - EXECUTION

### 3.1 FILTER MEDIA

A. Media as selected in equipment schedules on the Drawings.

B. Construction filters:

1. Type 1 for all equipment: roll media not acceptable.
2. Type 2 filter media is intended to be utilized over return/exhaust air grilles, registers and/or open ductwork during the construction period when the systems are being operated. This filter media is not to be utilized inside the housing of any HVAC systems.

C. Spare Filters:

1. Provide three (3) sets of spare filters for each piece of HVAC equipment and filter grilles.

### 3.2 INSTALLATION

A. Factory installed in air handling equipment.

B. Coordinate with work of other trades.

C. Install Air Cleaning Devices in accordance with manufacturer's written installation instructions.

D. See Section 230900 – Energy Management & Control Systems.

E. See Section 230593 – Testing, Adjusting, and Balancing.

### 3.3 START-UP PROCEDURES

A. Do not operate air handling unit fan systems for any reason until spaces served have been cleaned of dust and debris, to avoid contamination of supply air or return air paths and equipment.

B. Supply fans shall not be operated unless filters are installed, including temporary filters for use during test and balance.

C. If the final pressure drop of the temporary filters is reached during test and balance, replace them with a spare set.

D. Before turning system over to the Owner, remove temporary construction filters and install clean final filters:

1. Remove prefilters in front of cartridge, bag, and HEPA filters after construction and do not replace. Prefilters shall not be used during normal operation.
2. See also Section 230593 – Testing, Adjusting, and Balancing, Section 230010 – Mechanical General Provisions and Section 230500 – Basic

Materials and Methods for media installation during temporary equipment operation and test and balance periods.

## 3.4 INSPECTION

A. Verify that adequate clearance between Air Cleaning Devices and adjacent walls or equipment is available to permit maintenance and replacement of filters.

B. Verify that filters are firmly seated in frame to minimize bypass.

## 3.5 TRAINING

A. See Section 230010 – Mechanical General Provisions.

END OF SECTION

SECTION 23 81 46 - WATER-SOURCE UNITARY HEAT PUMPS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section includes unitary heat pumps with refrigerant-to-water heat exchangers, refrigeration circuits, and refrigerant compressor(s).

### 1.3 SUBMITTALS

A. See Section 230010 Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop and coordination drawings (where shop and coordination drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Water source heat pumps | R | R | | R |
| Controls | R | R | | |
| Accessories | R | R | | |
| Installation details | | | | R |

### 1.4 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of water-source unitary heat pumps that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, refrigeration components.
2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models are acceptable.

1. Climate Master.
2. Trane.
3. Florida Heat Pump.
4. Or equal.

### 2.2 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:

1. ASHRAE 15.

B. Comply with NFPA 70.

C. Comply with safety requirements in UL 484 for assembly of free-delivery, water-source heat pumps.

### 2.3 WATER-SOURCE UNITARY HEAT PUMPS

A. Description: Packaged water-source unitary heat pump with temperature controls; factory assembled, piped, wired, tested, and rated according to ASHRAE/ARI/ISO-13256-1.

1. 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. Cabinet and Chassis: Galvanized-steel casing with the following features:

1. Access panel for access and maintenance of internal components.
2. Knockouts for electrical and piping connections.
3. Cabinet Insulation: Foil-backed, glass-fiber liner, minimum 1/2 inch thick, complying with UL 181, ASTM C 1071, and ASTM G 21.

C. Console type: Cabinet and Chassis:

1. Cabinet: The cabinet shall be constructed of galvanized steel, with exposed edges rounded. The steel shall include electrostatic powder paint in three attractive colors for an appliance. grade finish. Service to the refrigerant and controls shall be provided through a single access panel at the front of the unit chassis. Insulation for the internal

parts and surfaces exposed to the conditioned air stream shall be made of moisture resistant insulation.
2. 1/2-inch thick dual density bonded glass fiber insulation.
3. Access for inspection and cleaning of the unit drain pan, coils and fan section shall be provided.

D. Supply Fan and Motor.

1. Direct drive centrifugal fan.
2. The fan motor shall be an electrically commutated motor, variable speed ball bearing type motor. EC motor shall provide soft-starting, maintain
3. The ECM fan motor shall provide soft starting, maintain constant CFM over its static operating range and provide airflow adjustment on its control board.
4. Fan motor shall be isolated from the housing by rubber grommets.
5. Motor shall be permanently lubricated and have thermal overload protection.

E. Drain Pans.

1. Drain pan shall be constructed of stainless steel.
2. Drain pan shall be fully insulated.

F. Water Circuits:

1. Refrigerant-to-Water Heat Exchangers:

a. Coaxial heat exchangers with copper water tube, with enhanced heat-transfer surfaces inside a steel shell; both shell and tube are leak tested to a minimum 450 psig on refrigerant side and 400 psig on water side.

G. Refrigerant Circuit Components:

1. Sealed Refrigerant Circuit: Charge with R-410A refrigerant.
2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.
3. Charging Connections: Service fittings on suction and liquid for charging and testing on each circuit.
4. Reversing Valve: Four-way, solenoid-activated valve designed to be fail-safe in heating position with replaceable magnetic coil.
5. Compressor:

a. Scroll.
b. Installed on vibration isolators and mounted on a structural steel base plate and full-length channel stiffeners.
c. Exterior of compressor shall be wrapped with a high-density sound-attenuating blanket and housed in an acoustically treated enclosure.
d. Factory-Installed Safeties:

1) Antirecycle timer.

2) High-pressure cutout.
3) Low-pressure cutout or loss of charge switch.
4) Internal thermal-overload protection.
5) Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35 deg F.
6) Water-coil, low-temperature switch.

6. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.
7. Pipe Insulation: Refrigerant minimum 3/8-inch- thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-developed indexes according to ASTM E 84.
8. Refrigerant Metering Device: Thermal-expansion valve.

H. Energy Management and Control System (EMCS) Interface:

1. BACnet Communication Interface. The BACnet Communication Interface for integration into the Energy Management and Control System. BACnet Communication Interface shall utilize the BACnet protocol over an MS/TP communications link.
2. See drawings for minimum points mapped through EMCS interfaces.

I. Controls:

1. Basic Unit Control Modes and Devices:

a. Unit shutdown on high or low refrigerant pressures.
b. Unit shutdown on low water temperature.
c. Low- and high-voltage protection.
d. Overcurrent protection for compressor.
e. Random time delay, three to 10 seconds, start on power-up.
f. Time delay override for servicing.
g. Control voltage transformer.
h. Water-coil freeze protection (selectable for water or antifreeze).
i. Automatic intelligent reset. Unit shall automatically reset five minutes after trip if the fault has cleared. Should a fault reoccur three times sequentially, lockout requiring manual reset occurs.
j. Ability to defeat time delays for servicing.
k. Digital display to indicate high pressure, low pressure, low voltage, and high voltage.
l. The low-pressure switch shall not be monitored for the first 90 seconds after a compressor start command to prevent nuisance safety trips.
m. Remote fault-type indication at thermostat.
n. Selectable 24-V dc or pilot duty dry contact alarm output.
o. 24-V dc output to cycle a motorized water valve with compressor contactor.
p. Service test mode for troubleshooting and service.

q. Unit-performance sentinel warns when heat pump is running inefficiently.
r. Compressor soft start.

2. Wall mounted zone sensor.

a. Wall mounted sensor with LCD display.
b. Zone temperature setpoint.
c. Zone occupancy override.
d. Status/fault indication.

J. Electrical Connection: Single electrical connection with fused disconnect.

1. Single-point power connection.

## 2.4 ACCESSORIES

A. Discharge air temperature sensor.

B. Hose Kits: Tag hose kits to equipment designations.

1. Minimum Working Pressure: 400 psig.
2. Operating Temperatures: From 33 to 211 deg F.
3. Hose Length: 24 inches.
4. Minimum Hose Diameter: Equal to water-source unitary heat-pump piping connection.
5. Hose Material: Braided stainless steel with adapters for pipe connections.
6. Isolation Valves: Two-piece, bronze-body ball valves with stainless-steel ball and stem, standard-port threaded connections, and galvanized-steel lever handle. Valves shall be factory installed on supply and return connections of both load-side and source-side heat exchangers. If balancing valve is combination shutoff type with memory stop, the isolation valve may be omitted on the return.
7. Strainer: Y-pattern with blowdown valve in supply connections of both load and source side of heat exchangers.
8. Balancing Valves: Mount in return connection. Include meter ports to allow flow measurement with differential pressure gage.

a. Balancing valve, factory set to operate within 10 percent of design flow rate over a pressure range of 2 to 80 psig.

9. Water-Regulating Valve Assemblies: A direct acting valve regulates discharge pressure during the cooling cycle, and a reverse acting valve regulates the suction pressure during the heating cycle. Valves shall close when heat-pump compressor is not running.
10. Motorized Water Valve: Stop water flow through the unit when compressor is off. Slow-acting, 24-V dc valve with threaded connections is installed between isolation valves and heat exchanger.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

B. Examine roughing-in for piping and electric installations for water-source unitary heat pumps to verify actual locations of piping connections and electrical conduits before installation.

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

### 3.2 INSTALLATION

A. Equipment Mounting:

1. Install vertical water-source, unitary heat pumps on existing bases.
2. Comply with requirements manufacturers written installation instructions.

B. Suspend water-source, unitary heat pumps from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Section 230529 – Hangers and Supports.

1. Install protective drain pans under all units installed above finished ceilings. See Section 230500 – Basic Mechanical Materials and Methods.

C. Install wall-mounting zone sensors in electrical outlet boxes at heights to match lighting controls or as required in Section 230913 – EMCS Basic Materials and Devices.

### 3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Connect supply and return hydronic piping to heat pump with hose kits.

B. Install electrical and control devices furnished by manufacturer but not specified to be factory mounted.

C. Install piping adjacent to machine to allow space for service and maintenance.

## 3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following field tests and inspections:

1. After installing water to water heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
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.

C. Heat pumps will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

## 3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Inspect for visible damage to unit casing.
3. Inspect for visible damage to compressor and coils.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Adjust vibration isolators.
9. Start unit according to manufacturer's written instructions.
10. Complete startup sheets and attach copy with Contractor's startup report.
11. Inspect and record performance of interlocks and protective devices; verify sequences.
12. Operate unit for an initial period as recommended or required by manufacturer.
13. Verify thermostat calibration.
14. Inspect controls for correct sequencing of heating, refrigeration, and normal and emergency shutdown.

## 3.6 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source unitary heat pumps.

END OF SECTION

SECTION 23 84 16 – DEHUMIDIFIERS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:

1. In-line Dehumidifiers.

### 1.3 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

### 1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with three (3) years documented experience.

### 1.5 SUBMITTALS

A. See Section 230010 Mechanical General Provisions.

B. Submit product data, O&M data, and samples and show item on shop and coordination drawings (where shop and coordination drawings are required) according to the following table.

1. "R" means required.
2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

| Item | Product Data | O&M Manual | Samples | Shop Drawing |
|---|---|---|---|---|
| Dehumidifier | R | R | | R |

| | | | | |
|---|---|---|---|---|
| Accessories | R | R | | R |

1.6 WARRANTY

A. Provide a one (2) two-year warranty including all accessories (parts and labor).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models are acceptable.

1. Quest Dry
2. Honeywell.
3. Lennox
4. Or equal.

2.2 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.3 IN-LINE DEHUMIDIFIERS

A. Furnish and install in-line dehumidifiers of the sizes and capacities shown on the Drawings.

1. Dehumidifier shall remove the minimum pints per day of water per mechanical schedules.
2. Dehumidifier shall be capable of a fresh air connection.
3. A minimum of a MERV-11 filtration required.
4. Auto-restart after power outages
5. R410A refrigerant

2.4 ACCESSORIES

A. Supply and install the following accessories in accordance with the manufacturer's recommendation.

1. Controller

a. Digital control of relative humidity.
b. Fan filter operation
c. Programmable ventilation timer
d. High temperature cut-out

e. Dryout cycle timer
f. Auto Reboot
g. LCD Display

2. Condensate Pump

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Coordinate with work of other trades.

B. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

C. All installations shall be in accordance with manufacturer's published recommendations.

D. Install in accordance with ARI 630.

E. Connect outlet of unit to drain piping. Provide ball valve.

F. Install the unit with space to access the back and side panels for maintenance and service and also to allow easy access to the filter cover panel. DO NOT INSTALL UNIT WITH THE FRONT PANEL OR FILTER COVER PANEL INACCESSIBLE

G. A drain pan SHALL be placed under the unit if installed above an area where water leakage could cause damage

H. Place the dehumidifier on supports that raise the base of the unit 2.5" above the top of the flanges on the drain pan beneath it. Do not place the dehumidifier directly on structural building members without vibration absorbers.

I. The dehumidifier may be suspended with steel hanger straps or a suitable alternative from structural members, unit must be supported from underneath. Don't hang from sides or ends.

J. Condensate drains by gravity via the drain port. Use 3/4" male NPT PVC pipe. Route drain pipe to drain. Install a trap if possible. Take care when installing drain pipe to drain port. Use an adjustable wrench to secure the drain port. An optional condensate pump kit may be installed if a lift is required to dispose of the condensate.

### 3.2 STARTUP AND TESTING

A. Start-up by a factory authorized technician.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain dehumidifiers.

B. See Section 230010 – Mechanical General Provisions.

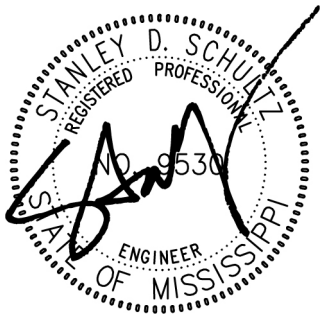
END OF SECTION

DIVISION 26 - ELECTRICAL SYSTEMS

TABLE OF CONTENTS


| | | |
|---|---|---|
| 260010 | General Provisions | 260010 -1 / 4 |
| 260020 | Codes & Standards | 260020 -1 / 1 |
| 260030 | Electrical Equipment/Material Submittals | 260030 -1 / 2 |
| 260100 | Basic Materials & Methods | 260100 -1 / 3 |
| 260110 | Raceways & Fittings | 260110 -1 / 7 |
| 260120 | Boxes & Enclosures | 260120 -1 / 4 |
| 260130 | Low-Voltage Conductors | 260130 -1 / 3 |
| 260150 | Enclosed Busway Systems | 260150 -1 / 2 |
| 260250 | Grounding & Bonding System | 260250 -1 / 3 |
| 260310 | Panelboards | 260310 -1 / 6 |
| 260350 | Dry-Type Transformers | 260350 -1 / 2 |
| 260410 | Wiring Devices | 260410 -1 / 6 |
| 260420 | Lighting Luminaires | 260420 -1 / 3 |
| 260450 | Equipment Electrical Services | 260450 -1 / 3 |
| 260510 | Telecommunication Raceway System | 260510 -1 / 3 |


END OF DIVISION 26 TABLE OF CONTENTS




09/14/2021

260010 GENERAL PROVISIONS

1. GOVERNING CLAUSE

1.1 For the sake of brevity, these specifications may omit phrases such as “Contractor shall provide”, “unless otherwise indicated or specified”, etc., but these phrases are nevertheless implied. Mention of materials and operations requires the Contractor to furnish, install and connect such materials and perform such operations to provide a complete and operating system to the satisfaction of the Professional.

2. GENERAL CONDITIONS

2.1 The General Conditions, Supplementary General Conditions, Information to Bidders, General Requirements, Addenda, Alternates and other pertinent documents issued by the Professional are a part of these specifications and shall be complied with in every respect.

2.2 Notwithstanding any reference in the specifications to any equipment, material or type of construction by name, make or catalog number, such reference shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Where the phrase “or approved equal” is used in the Division 26 Specification, substitute equipment, equivalent in all respects to that specified, of any qualified manufacturer is permitted with the written approval of the Professional. Approval will not be considered until after award of contract and only if submitted by the successful Contractor. Where a list of manufacturers and/or catalog numbers is provided and the phrase “or approved equal” is omitted, substitute equipment, equivalent in all respects to that specified, from one of the listed manufacturers is permitted with the written approval of the Professional.

3. TEST AND OBSERVATIONS

3.1 The complete project shall be, during and/or after construction, subject to the tests and observations as herein described and as noted on the drawings. Deficiencies found as a result of these tests and observations shall be corrected by the Contractor within a reasonable period and at no expense to the Owner.

3.2 The complete project shall be subject to observations and tests conducted by the Professional or for him in his presence. Upon notice, the Contractor shall furnish not to exceed two men, one to include the job foreman, and tools to assist and be directed by the Professional for a reasonable amount of time to make such tests and observations as are requested by the Professional.

3.3 The complete project shall be subject to observations and tests conducted by any Federal, State and/or local authority having jurisdiction. The Contractor shall make all corrections of any deficiencies required by the authority having jurisdiction to allow building occupancy.

3.4 The complete project shall be subject to observations and tests conducted by the Owner’s Insurance carrier. After inspection by this agency, Contractor shall make corrections of any deficiencies found adversely affecting the insurance to be carried by the Owner. Acceptance of this report or subsequent reports lie with the Professional or Owner.

4. RECORD DOCUMENTS

4.1 The contractor shall provide to the Professional with the Close-Out Documents the following:

a. Two (2) sets of blue line “as-built” prints of same scale as original drawings legibly marked in red showing all variations in the installed work from the requirements of the original contract drawings. The “as-built” drawings shall include all addenda, approved and installed change orders, field condition changes and other departures from the original plans and specifications.

b. Three (3) sets of shop drawings and other data required by the specifications reflecting the manufacturer's shop fabrication of the materials actually installed. The Division 26 shop drawings shall be separately post bound, indexed and tabbed by specification section. Faxed or copies of faxed material shall NOT be used in Close-Out Documents.

c. Operation and maintenance manuals and manufacturer’s instructions for all equipment and systems installed.

d. Copy of all reports of system, equipment or material test as required by this specification.

e. In addition to the red-line marked blue line prints, furnish a complete set of corrected drawings on 3-1/2" HD disks or Compact Disk in DXF format fully compatible with AutoCad software. Verify with the Professional prior to compiling information the required storage media, format and software revision.

5. GUARANTEE

5.1 The Contractor shall guarantee to the Owner all work performed under this contract to be free from defects in workmanship and materials for a period of one year from the date of final acceptance by the Professional and the Owner except as hereinafter noted.

5.2 The Contractor shall correct, repair and/or replace upon notice from the Owner or his authorized representative within a reasonable period of time any defects in the work performed under this contract arising during the warranty period. This repair work shall be provided at no additional cost to the Owner.

5.3 Lighting luminaire lamps are hereby exempt from the one-year guarantee as follows with the exception that all lamps are to be operating upon final acceptance of the project:

a. All incandescent lamps shall be warranted for thirty (30) days after the date of final acceptance by the Owner. Lamp burn-outs occurring within this time frame shall be recorded by the Owner and will be reported to the Professional at the end of this warrantee period. Upon notice from the Professional, the Contractor shall furnish and install replacement lamps for each lamp burn-out reported.

b. All gaseous vapor discharge lamps shall be warranted for one hundred eighty (180) days after the date of final acceptance by the Owner. Lamp burn-outs occurring within this time frame shall be recorded by the Owner and will be reported to the Professional at the end of this warrantee period. Upon notice from the Professional, the Contractor shall furnish and install replacement lamps for each lamp burn-out reported.

6. ELECTRICAL SYSTEMS SCHEDULE

6.1 Provide and connect all equipment and materials for complete and operative systems as follows:

Electrical Busway System.
Power Outlets & Connections to all Motors & Equipment.
Lighting & Control System.
Telecommunication System Raceways.
Telecommunication Horizontal Cabling System.
Fire Detection & Alarm System.
Security/Access Control System Provisions.
Miscellaneous Systems as shown on the drawings or stated herein.

7. EXISTING CONDITIONS

7.1 This project requires renovations and/or additions to existing facilities and additions and modifications to existing systems. The Contractor is responsible for visiting the site and verifying all existing conditions prior to bid and making necessary adjustments to the electrical installations to accommodate the existing conditions.

7.2 The Owner will occupy portions of the facility(ies) during the construction period. All existing areas not under construction and scheduled to be occupied or used by the Owner shall remain in full operation with all existing systems active unless specifically noted otherwise on the drawings or herein specified.

7.3 Electrical service to areas occupied or used by the Owner shall not be interrupted except with the approval of the Professional. Electrical service interruptions shall occur at the convenience of the Owner and with proper advance notification. This may require week-end and after-hours labor and this labor shall be provided as required.

7.4 Prior to the beginning of any new work or demolition, the Contractor shall review and test the existing system(s) to be modified and note in writing to the Professional any deficiencies or visible code violations. It is advised that the condition and operation of existing systems in close proximity to the new work be noted as well. These notations will be used to determine the final operating condition of systems at the completion of the project.

7.5 This project will be phased to allow Owner occupancy or use of portions of the facility(ies). The Contractor shall review the phasing instructions issued in the Contract Documents and shall provide all necessary provisions to accommodate the project phasing including temporary electrical services as required.

7.6 The areas of demolition and/or new work required by this project are in a vital function area(s) of this facility(ies). Therefore, no interruption or interference will be permitted in the day-to-day operation. When working over equipment, complete coverage of the equipment shall be required to protect equipment from debris. When a work period is completed, all materials will be removed and the entire area cleaned at least equal to that found. All circuits shall be left operational including lighting, new or existing.

7.7 Existing special systems to remain active during construction.

a. This project requires modification or replacement of the existing Fire Detection and Alarm System. This system is vital to the safe operation of this facility; therefore, the system(s), either the existing or the new, in the Owner occupied spaces shall be in full operation during normal operating hours without interruptions. The Contractor shall provide all necessary equipment, material and labor required to accomplish this requirement.

8. DEMOLITION

8.1 In the areas shown on the drawings to be renovated, other areas specifically noted, or as required for the installation of the new work, disconnect and remove all existing electrical equipment, lighting luminaires, wiring devices, etc. and associated branch circuits unless noted otherwise. Removal of branch circuits shall include exposed conduits, surface boxes and conductors back to next in-line active device, junction or over-current protection device. Cut back and cap all abandoned concealed conduits. Provide blank cover on all abandoned flush mounted junction boxes in existing walls to remain without new finishes.

8.2 Disconnect and remove the existing electrical service entrance equipment, electrical distribution equipment and associated feeder circuits. Removal of feeder circuits shall include exposed conduits, surface boxes and conductors back to over-current protection device. Cut back and cap all abandoned concealed conduits. Provide blank cover on all abandoned flush mounted junction boxes in existing walls to remain without new finishes.

8.3 Maintain and restore, if interrupted, all existing feed-thru feeder and/or branch circuits serving areas not under renovation or other areas outside the scope of this project.

8.4 The Owner shall have first rights of salvage of all demolished equipment and/or material. Demolished equipment and/or material not retained by the Owner shall be removed from the site and properly disposed of by the Contractor subject to the demolition directive issued by the Professional.

- END OF SECTION 260010 -

260020 CODES & STANDARDS

1. GENERAL

1.1 Use only NEW equipment and materials of current manufacturer. Equipment/material shall be of current production from manufacturers' of long experience in the manufacture of such types of equipment/material and who are regularly engaged in the production of this type of equipment/material.

1.2 Equipment/materials shall be installed and connected in strict compliance with manufacturer's recommendations unless these requirements are exceeded as noted on the drawings or specified herein.

1.3 All equipment supplied shall have local service representation where applicable.

1.4 Equipment and materials shall be installed and connected in a neat and workmanlike manner.

2. CODES

2.1 Electrical equipment/material and their installation and connection shall strictly comply with the latest editions and applicable sections of the following listed codes and all applicable federal, state and local codes:

National Electrical Code (NEC) - NFPA 70
NFPA 101 - Life Safety Code
National Fire Protection Association (NFPA)
International Building Code (IBC)
National Electrical Safety Code (ANSI-C2)

3. STANDARDS

3.1 All equipment/material shall be manufactured in compliance with applicable National Electrical Manufacturers Association (NEMA), American National Standards Institute (ANSI) and NEC Standards and requirements.

3.2 All equipment/materials provided and connected shall be listed by Underwriter's Laboratory (UL) when such listings are issued for the type of equipment/materials. All equipment/material shall be installed and connected in full compliance with their UL listing.

- END OF SECTION 260020 -

260030 ELECTRICAL EQUIPMENT/MATERIAL SUBMITTALS

1. GENERAL

1.1 Equipment is specified by manufacturer's name and catalog number and is intended to establish the minimum standards of quality acceptable.

1.2 Substitute equipment, equivalent in all respects to that specified, is permitted with the written approval of the Professional. Approval will not be considered until after award of contract and only if submitted by the successful Contractor.

1.3. The manufacturer's name and/or catalog number first mentioned in this specification is considered to be the specified equipment. The "or equal" manufacturers mentioned or other manufacturers proposed by the Contractor shall be considered as substituted equipment.

1.4 Substituted equipment shall meet the dimensional and functional requirements of the building as represented by the plans and specifications. All revisions to the contract precipitated by the use of substituted equipment shall be incorporated by the Contractor, after approval in writing by the Professional, and at no additional cost to the Owner.

1.5 The Professional's review and approval of the shop drawings is only for general conformance with the design concept of the Project and the information given in the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site; information that pertains solely to the fabrication process or to the means and methods of construction; coordination of work of all trades; and performing all work in a safe and satisfactory manner. Review and/or approval of the shop drawings does not modify the Contractor's duty to comply with the Contract Documents. Any equipment or work found in the judgement of the Professional to be defective or otherwise unsuitable shall be repaired or replaced by the Contractor at no additional cost to the Owner.

1.6 Shop drawings submitted for review for any substituted equipment shall have all deviations from the specified equipment clearly indicated and highlighted. This includes all functional characteristics, dimensional characteristics, finish characteristics, etc. Shop drawings for substituted equipment not clearly indicated with deviations will be returned to the Contractor without being reviewed.

1.7 If requested in writing by the Professional, the Contractor shall submit a scale drawing (scale as directed by the Professional) of any electrical equipment area, conduit layout or the like which in the opinion of the Professional may present difficulty regarding space allocation or clearances.

2. SUBMITTALS

2.1 After the project notice to proceed has been issued and with promptness to assure reasonable time for review with no delay to the project, the Contractor shall submit to the Professional a minimum of six (6) copies of shop drawings for all equipment and material for the electrical systems for approval whether or not substituted equipment or materials.

2.2 The Contractor shall include with his shop drawing submittals a copy of the electrical service characteristics letter required by Section 260450. Shop drawings submitted without this letter attached will not be reviewed until this letter is provided.

2.3 Shop drawings shall be post-bound, indexed and tabbed per the appropriate specification sections. All material/equipment shop drawing cut sheets shall be properly located under the appropriate specification section. All shop drawings shall be originals (no faxed copies) and shall be readable without being removed from the bindings. All information listed on the shop drawings shall be typed. Handwritten information will not be accepted.

2.4 Space shall be provided on the title or index page of each section of the shop drawings for the Professional's review stamp and comments. This space shall be clearly labeled as to its use and shall have a minimum size of 7" wide X 5" high.

2.5 All submitted equipment/material and associated options, accessories, special features, etc. shall be clearly marked and indicated on all copies of the shop drawings. Provide appropriate shop drawings on all required accessory equipment.

2.6 All shop drawings for all systems, equipment and materials including any required one-line drawings, diagrams, etc. shall be submitted together. Partial submittals will not be reviewed without prior consent. Special systems provided by specialized vendors or distributors may be submitted in a separate binder.

2.7 Provide complete shop drawings with all pertinent information for the following equipment and/or systems and all required components:

Panelboards.
Circuit Breakers.
Dry-Type Transformers.
Conduits, Boxes and other Raceway Systems.
Conductors, 600V.
Required Cable Test Reports.
Switches.
Receptacles.
Miscellaneous Wiring Devices.
Lighting Luminaires and Accessories.
Telecommunication Horizontal Cabling System Components.

- END OF SECTION 260030 -

260100 BASIC ELECTRICAL MATERIALS & METHODS

1. COORDINATION

1.1 This Contractor shall familiarize himself with the general construction and building systems of all divisions specified in the Contract Documents. Fully coordinate the installation of all electrical equipment and materials with the general construction work and work of other divisions of the specifications prior to the start of the installation. Notify the Professional, prior to installation, of conflicts between electrical and structural, architectural, mechanical, etc. work.

1.2 Layout and installation of Division 26 work shall be the responsibility of this Contractor and all conflicts with other trades shall be resolved by the Contractor and approved by the Professional prior to installation.

1.3 Sequence, coordinate and integrate installing electrical equipment and materials for efficient flow of the work. Coordinate the installation and positioning of large equipment before closing in the building. Providing appropriate pathways, lifting devices, etc. for the installation of electrical equipment and/or materials in new or existing facilities is the responsibility of this Contractor.

1.4 Fully coordinate prior to installation all Utility Company services including metering facilities to the facility with the appropriate serving Utility Company. Comply with the requirements of the serving Utility Companies.

1.5 The electrical drawings are not to scale. Follow architectural, equipment supplier shop drawings, and manufacturer's shop and installation drawings for accuracy. Coordinate the installation of electrical devices, equipment and/or materials with the architectural drawings, features and finishes for the space where installed.

2. ELECTRICAL IDENTIFICATION

2.1 Electrical equipment, devices, outlets, conductors, etc. shall be properly and legibly labeled as specified herein.

2.2 Conductors or wiring shall be labeled using tape markers of vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.3 Engraved plastic labels, signs, etc. shall be melamine plastic laminated punched or drilled for mechanical fasteners and shall be properly secured to associated equipment or device. Engraved legend shall be black letters on white background. Minimum label thickness shall be 1/16".

2.4 Where equipment, circuit, etc. identification requires the use of building room numbers and room names, the numbers and names used shall be the final designations issued by the Professional as they appear on the building signage. These designations may or may not be as they are indicated on the Contract Drawings. The Contractor is responsible for fully coordinating the room designations with the Professional.

3. ELECTRICAL EQUIPMENT & MATERIAL INSTALLATION

3.1 Equipment and materials shall be installed and connected in a neat and workmanlike manner.

3.2 Install equipment and materials level, plumb, and parallel and perpendicular to other building systems' elements and components unless otherwise indicated.

3.3 Install equipment to facilitate service, maintenance, and repair or replacement of components.

3.4 Electrical equipment and devices shall be mounted at the height specified in the appropriate sections or as indicated on the drawings. Mounting heights may be adjusted slightly to permit cutting of masonry block to the top or bottom of the block course nearest the required height. All heights shall be consistently cut above or below the block coursing so that they are the same height above the reference.

3.5 The mounting heights of electrical equipment and material shall reference the height above the finished floor or grade above which they are mounted. Mounting heights specified shall reference the center of the box, device, switch or circuit breaker operating handle unless indicated otherwise.

3.6 Electrical switchboards, panelboards, motor control centers, disconnect switches, etc. shall be installed with the proper dedicated electrical spaces and working spaces as required by the NEC.

4. FIRE STOPPING

4.1 Openings around electrical penetrations through smoke or fire rated wall, partition, floor or ceiling assemblies shall be smoke and/or fire stopped using an approved UL listed system designed for the materials encountered to maintain the smoke and/or fire rating of the assembly.

4.2 All fire proofing in rated walls, partitions, floors or ceiling assemblies shall be performed by a certified Fire Proofing Contractor. The Division 26 Contractor shall be responsible for procuring and coordinating with the Fire Proofing Contractor to provide the required fire proofing of all electrical penetrations in or through rated assemblies.

5. CUTTING & PATCHING

5.1 Cut, channel, chase and/or drill floors, walls, partitions, ceilings and other surfaces required to permit electrical installations. Obtain permission in writing from the Professional and the General Contractor prior to cutting or penetrating any structural member.

5.2 Repair and refinish disturbed finish materials and other surfaces indoors and out-of-doors to match adjacent undisturbed surfaces and/or to existing condition prior to work performed.

5.3 Use experienced and skilled mechanics of the trades involved or employ appropriate sub-contractor to perform all repair and refinishing.

5.4 All roof penetrations shall be weatherproofed by the Division 7 Contractor. Division 26 Contractor shall be responsible for procuring and coordinating with the Division 7 Contractor to weatherproof all roof penetrations created by the Division 26 work.

6. CLEANING & PROTECTING

6.1 Properly protect equipment and installations during the construction period to ensure that components, coatings, finishes, cabinets and enclosures are without damage or deterioration at the time of acceptance by the Owner.

6.2 On completion of construction within an area, inspect exposed finish of outlets, devices, fixtures, equipment, etc. Remove burrs, dirt, paint spots and construction debris.

6.3 Provide touch-up paint on equipment finishes marred during the construction or installation process. Paint shall be as recommended by the equipment manufacturer and shall match the installed equipment finish.

7. HAZARDOUS LOCATIONS

7.1 All electrical equipment/devices/luminaires and associated branch circuitry located within or passing through hazardous locations as defined by the NEC shall be installed in strict compliance with Article 500 of the NEC and as shown on the drawings. Areas affected are as noted on the drawings and/or as implied by area name given on the Architectural Drawings.

7.2 All wiring shall be installed in galvanized rigid steel, intermediate metal conduit or Type MI cable with proper fittings and boxes approved for installation in the hazardous location rating encountered as defined by the NEC.

7.3 Seal-off fittings shall be installed where indicated on the drawings, where conduits enter/leave hazardous location boundaries and as required by the NEC. Where a seal-off fitting must occur in a finished area, it shall be installed in a flush mounted wall junction box with stainless steel cover. Where a seal-off fitting is installed in an unfinished area, it shall be surface mounted in an accessible location as directed and approved by the Professional. Seal-off fittings shall be Crouse-Hinds type EYS or approved equal with proper sealing compound installed after cable installation.

7.4 All electrical equipment, devices, etc. installed within the boundaries of a hazardous location as defined by the NEC shall be specifically approved for installation and operation in the hazardous location rating encountered as defined by the NEC.

- END OF SECTION 260100 -

260110 RACEWAYS & FITTINGS

A. METALLIC RACEWAYS

1. GENERAL

1.1 All power branch circuit/feeder wiring and other systems' wiring as specified shall be in metallic conduit unless specifically noted otherwise on the drawings or herein specified.

1.2 Conduits shall be hot-dipped galvanized rigid steel (GRS) per ANSI C80.1/UL 6, intermediate conduit (IMC) per ANSI C80.6/UL 1242 or electrical metallic tubing (EMT) per ANSI C80.3/UL 797 unless specifically shown or noted otherwise on the drawings or herein specified.

1.3 Size conduits as shown on the drawings or where size is not shown follow the requirements of the NEC. Four-wire branch circuit homerun conduit shall be 3/4" trade size minimum. Homeruns shall not exceed the number of conductors shown on the drawings unless specific approval is given by the Professional.

1.4 Where conduit bends/elbows for power circuits are required to be long radius, the minimum bend radius shall be eight (8) times the conduit trade size for conduits 2" or greater and six (6) times the conduit trade size for conduits less than 2" unless otherwise directed by the Professional.

1.5 Conduit bends/elbows for communication systems shall be long radius type. The minimum bend radius shall be ten (10) times the conduit trade size for conduits 2" or greater and six (6) times the conduit trade size for conduits less than 2" unless otherwise directed by the Professional.

1.6 All conduit bends/elbows uses in conduit systems for electrical service entrances and feeders shall be long radius type unless available installation space is prohibited by the building's structural elements, construction type, etc.

1.7 Wireways (gutters) shall not be used unless specifically shown or noted on the drawings or with specific approval from the Professional.

2. CONDUIT MATERIAL

2.1 Conduit shall be provided in accordance with the following schedule unless shown or noted otherwise on the drawings or herein specified:

a. In suspended ceiling construction or non-masonry partitions: GRS, IMC or EMT.

b. In masonry partitions: GRS, IMC or EMT.

c. In any poured concrete: GRS or IMC.

d. In exposed locations indoors: GRS, IMC or EMT.

e. In exposed locations out of doors: GRS or IMC. All conduits buried in earth shall be GRS with polyvinyl, polyethylene or asphaltum coating.

f. All feeders shall be run in GRS or IMC.

g. All electrical power conduits in excess of 1 1/4" trade size shall be GRS or IMC.

2.2 Rigid non-metallic conduit (RNC) may be used only where specifically shown or noted on the drawings or herein specified.

3. FLEXIBLE CONDUIT

3.1 Flexible conduit shall be steel. Use not to exceed six (6) feet of flexible metal conduit for connection to motors and/or recessed fixtures unless otherwise specified herein.

3.2 Flexible conduit used for connections subject to moisture under normal conditions or where specifically indicated or noted shall be liquid-tight with proper liquid-tight fittings.

3.3 All flexible conduit shall have properly sized bonding jumper installed within. The grounding conductor shall be sized as indicated or in accordance with the NEC.

3.4 All final connections to motors, transformers or other vibrating equipment shall be with flexible conduit suitable for the environment installed.

4. INSTALLATION/ROUTING

4.1 All conduits shall be routed concealed above/within ceilings, wall partitions, floors, etc. unless specifically shown or noted otherwise on the drawings or stated herein.

4.2 Route conduits parallel and/or perpendicular to walls, ceilings or floors weather concealed or exposed. Homerun conduits shall be combined to form a common routing path and supported from the building structure by trapeze style hangers.

4.3 Conduits shall NOT be routed horizontally on the roof without specific approval from the Professional.

4.4 Make field bends and offsets in conduits in accordance with the NEC and so as not to reduce the internal diameter.

4.5 Install raceways with a minimum number of bends in the shortest practical distance, considering building construction and obstructions and other requirements of the drawings and this specification. Provide accessible junction/pull boxes per the NEC to limit distance between pull points to 100 feet or in conduit runs where total raceway bends exceed 360 degrees.

4.6 Branch circuit, telecommunication and other systems' conduits shall not be routed in/under floor slab unless specifically shown or noted on the drawings to be installed in that manner,

the adjacent building construction methods prohibit concealed overhead routing, or the nature of the connected device/box (i.e. floor boxes) requires this type of routing.

4.7 Where conduits are shown or required to be concealed in concrete slabs in contact with earth, conduits 1/2" through 1" trade size shall be installed in and not under slabs. Conduits in excess of 1" trade size shall be installed under slab and shall have two coats of asphaltum paint applied or shall be coated with polyvinyl, polyethylene or other approved coatings. Where conduit symbol indicates conduit concealed in floor slab and concrete thickness is less than four (4) inches, conduits shall be installed below slab. Conduits shall be routed as required so as not to compromise the structural integrity of any concrete.

4.8 Protect conduit stub-ups above floor slabs, finished grade, etc. from damage during and after the construction period. Provide temporary closures to prevent entrance of moisture or debris into conduits and make certain that conduits are clear of same before installing conductors.

4.9 Pull into all empty conduits one nylon pull string with not less than 200 lb. tensile strength. Leave at least 12 inches of slack at each end.

5. SUPPORTS

5.1 All conduits and conduit fittings shall be properly supported in accordance with the National Electrical Code and as follows:

a. By one-hole or two-hole straps properly attached to the building elements.

b. Where embedded in concrete, by at least three (3) rounds of #14 B&S gauge galvanized wire twisted around concrete reinforcing rods.

c. For exposed work, by one-hole or two-hole malleable iron clamps held in place by machine screws in expanding lead anchors in concrete or masonry or by screws in wood.

d. By conduit clamps properly attached to bar joists.

e. By bulb “T” clamps for conduits crossing bulb “T”’s.

f. Where groups of conduits occur or for feeder conduits where applicable, by trapeze hangers adequately supported by steel rods attached to the building structure using concrete inserts, welded supports, bolted supports, etc.

5.2 In suspended ceiling construction, do not support conduits from ceiling support system. Conduit and box systems shall be supported independently of both the tie wires supporting the ceiling grid system and the ceiling grid system into which ceiling panels are placed.

5.3 Supporting means shall not be shared between electrical raceways and mechanical piping or ducts unless specifically shown or noted otherwise.

6. CONDUIT FITTINGS/TERMINATIONS

6.1 All conduit fittings shall be steel or malleable iron. Die cast fittings shall not be used.

6.2 GRS and IMC conduit fittings:

a. Steel or malleable iron threaded couplings, elbows and conduit bodies.

b. Bushings: Shall be the insulating type of steel or malleable iron consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushing for conduits 1 1/4" or larger shall be the grounding type with a ground lug.

c. Locknuts: Shall be bonding type of steel or malleable iron with sharp edges for digging into the metal wall of enclosures/boxes.

6.3 EMT conduit fittings:

a. Couplings and connectors shall be insulated compression type of steel or malleable iron and shall be properly secured to each conduit or box.

6.4 Couple conduits together and connect to boxes, fittings and cabinets so as to provide effective electrical continuity. Assure ground continuity on GRS feeder and branch circuits by two locknuts, one inside and one outside of all boxes, cabinets and enclosures. Do not use couplings dependent on screws bearing on conduit.

6.5 Provide insulating bushing where conductors #4 or larger enter junction box, enclosure, cabinet or cutout box. Bushings shall be grounding type as manufactured by OZ/Gedney type "BLG", Thomas & Betts/Steel City or equal approved by the Professional.

6.6 Expansion fittings in conduits shall be provided where shown on the drawings or where conduits imbedded in concrete pass through an expansion joint(s). Expansion fittings shall be as manufactured by Crouse-Hinds Type XJG with internal grounding or equal approved by the Professional.

6.7 Provide seal-off fittings where shown on the drawings or as required by conditions encountered requiring seals. Seal-off fittings shall be installed where conduits are installed between areas of different temperatures where condensation may occur. These shall include, but not be limited to, refrigerators, freezers, air-handling units, environmental rooms and the building exterior. Seal-off fittings shall also be installed where conduits enter the building or a piece of equipment and there is a possibility of moisture migration thru the raceway to the equipment or into the building. Fittings shall be as manufactured by Crouse-Hinds Type EYS for horizontal and vertical runs, Type EYS elbow seals or equal approved by the Professional. All seals shall be properly installed in an accessible location using "Chico X" fiber and "Chico A" sealing compound.

B. RIGID NON-METALLIC CONDUIT (RNC)

1.1 Where specifically noted and/or indicated on the drawings, wiring may be installed in polyvinyl chloride (PVC) conduit per NEMA TC-2/TC-3//UL651. PVC conduit shall be sunlight-resistant, electrical grade, Schedule 40 minimum or Schedule 80 where indicated on the drawings as manufactured by Carlon, Triangle, PWC or equal approved by the Professional.

1.2 Installation of PVC conduit shall follow the applicable provisions of conduit installation/routing hereinbefore specified for metallic conduits and the manufacturer's recommendation unless exceeded by requirements shown on the drawings or this specification. All joints shall be made using approved and proper solvent cement to make all joints water tight.

1.3 Galvanized rigid steel (GRS) conduit shall be used where PVC conduit runs turn angles, rise vertically and/or are exposed.

1.4 PVC conduit shall not be stored nor have been stored in direct sunlight.

1.5 PVC boxes of equivalent dimension to those hereinafter specified under paragraph 260120 "BOXES AND FITTINGS" shall be used with PVC box connectors.

1.6 Where underground PVC conduits are shown and/or noted on the drawings to be used for communication systems and/or to be empty for future use, provide one #8 copper conductor in each conduit for full length of conduit for future locating purposes.

1.7 Where noted on the drawings, PVC conduits shall be electrical grade Schedule 40.

1.8 Where used for primary (medium voltage) service conductors and where noted on the drawings, Schedule 40 PVC conduits shall be concrete-encased as herein specified with a minimum of 3" concrete coverage on all sides.

C. SURFACE METAL RACEWAY SYSTEMS

1.1 Where shown or noted on the drawings, wiring shall be installed in surface metal raceway systems.

1.2 The routing and installation of surface metal raceway systems shall be fully coordinated with the architectural elements of the associated space and shall be fully coordinated with the Professional.

1.3 Surface metal raceway systems shall be provided as directed by the Professional with a finish color as selected by the Professional from the manufacturer’s standard colors and/or painted as directed to match the wall in which installed.

1.4 Surface metal raceways shall be as manufactured by Wiremold, Mono-Systems or equal approved by the Professional and shall meet the following requirements:

a. Raceways used shall be the minimum size adequate for the number of wires encountered and/or have minimum cross-sectional area equivalent to the trade-size conduit shown or specified.

b. Installation shall follow manufacturer's recommendations unless exceeded by the requirements noted herein or on the drawings.

c. Raceways shall be anchored with two-hole straps located within 6" of any termination and a maximum of 36" on center in between. Straps shall be anchored with the strongest method available in keeping with the architectural finishes encountered. Other support methods may be considered as recommended by the manufacturer and approved by the Professional.

d. Conversion from surface raceway to conduit shall be with proper surface metal raceway connector for the raceway size and situation encountered.

1.5 Where shown or noted on the drawings, surface metal raceway system(s) of steel construction with two compartments with metallic barrier for power and communication systems shall be provided. Raceways shall be provided with all required fittings, elbows, etc. for continuous runs as shown or noted on the drawings. Raceways shall be secured to the mounting surface as recommended by the manufacturer. Surface metal raceway system shall be as manufactured by Wiremold Series 4000 or equal in Mono-Systems or Thomas & Betts. Wiring devices and outlets as shown on the drawings and as herein specified shall be provided and connected in the surface metal raceway systems.

D. J-HOOK SYSTEMS

1.1 Where shown or noted on the drawings or herein specified, a j-hook system shall be provided for telecommunication and/or communication cabling systems. A separate j-hook system shall be provided for each system (i.e. voice, data, fiber optic, cable TV, etc.) installed, shown or noted to utilize j-hooks for cable routing.

1.2 J-hooks shall be 2" diameter with wide, flat base for cable support without kinking, bending or crimping of cables. J-hooks shall be installed such that cable bend radii are in compliance with EIA/TIA standards. J-hooks shall be as manufactured by Caddy or equal approved by the Professional.

1.3 J-hooks shall be installed above accessible ceilings where present in compliance with the manufacturer’s recommendations unless exceeded by requirements noted herein or on the drawings.

1.4 J-hooks shall be spaced a maximum of 5' on center or as recommended by the manufacturer(s) of the cables installed.

1.5 Where j-hook system paths cross partitions, unaccessible areas, etc. provide one 2" or size as shown on drawings conduit sleeve through wall partition or across unaccessible area for each j-hook system installed.

1.6 Route j-hook systems to avoid piping and ducts and to maintain adequate space for access in front of j-hooks. Fully coordinate with all other trades prior to rough-in and adjust routing as necessary.

- END OF SECTION 260110 -

260120 BOXES & ENCLOSURES

1. OUTLET BOXES

1.1 Provide proper outlet box at all fixtures/devices and outlet provision locations as shown on the drawings by symbols or specified herein.

1.2 All outlet boxes and raised covers shall be galvanized stamped steel unless otherwise noted on the drawings or specified herein.

1.3 Close all unused knockout holes and install galvanized device cover or blank cover on surface boxes and proper device plate or blank plate as specified herein on flush boxes.

1.4 Location of all outlets as shown on the drawings is approximate and representative unless dimensioned or specifically noted. See Architectural drawings, details and/or shop drawings for specific outlet locations. Any outlet/box and associated conduits/conductors may be moved from the location shown on the drawings in any direction up to a distance of ten (10) feet by direction of the Professional if so directed before the outlet/box has been installed.

1.5 Use outlet boxes at interior locations sized in accordance with the following schedule or in accordance with the NEC whichever dictates a larger box. Minimum conductor size to be used in determining power branch circuit box sizes shall be #12 AWG.

a. Switch box, 3"X2"X2 1/2" - 5 conductors maximum.

b. 4" octagon box, 1 1/2" depth - 6 conductors maximum.

c. 4" square box, 1 1/2" depth - 9 conductors maximum.

d. 4" square box, 2 1/8" depth - 13 conductors maximum.

e. 4 11/16" square box, 2 1/8" depth - 18 conductors maximum.

f. 4" octagon concrete box, 2 1/2" depth - 13 conductors maximum.

1.6 Use boxes of cast or malleable iron with threaded hubs for damp or wet locations, locations exterior to the building and in any poured concrete.

1.7 Mount boxes flush with finished surface. Provide plaster rings or square corner raised covers for tile or block walls so that fixtures/devices/plates will be perfectly flush mounted. Do not install outlet boxes back to back. Face of boxes shall not be installed more than 1/4" behind finished face of wall.

1.8 Where a single outlet box is installed in a metal or wood stud wall, the box shall be attached to the studs using a metal mounting bracket with support leg to prevent movement of box in wall at unattached side. Where two or three outlet boxes are shown and/or intended to located adjacent to each other in a metal or wood stud wall, the boxes shall be attached to the studs using a common metal mounting bracket with bracket stabilizer leg to support the middle portion of the bracket. Outlet box mounting brackets shall be as manufactured by Erico/Caddy or approved equal.

1.9 Outlet boxes installed in masonry walls shall be embedded in masonry grout so as to properly secure each box in place. The Division 26 Contractor is responsible for providing all materials and installing the outlet boxes as required.

1.10 Outlet/junction boxes shall be as manufactured by Thomas & Betts/Steel City, Raco, Appleton or equal approved by the Professional.

2. JUNCTION/PULL BOXES

2.1 Provide junction boxes or pull boxes as required by the NEC, field conditions encountered, etc. whether or not shown on the drawings. Box locations shall be fully coordinated with the Professional where boxes are to be exposed or where installation affects architectural elements, structural construction or mechanical systems.

2.2 Use stamped steel boxes for indoor junction/pull boxes where the appropriate box size is available for the conduit size(s) and the number of conductors encountered. Use screw cover metallic pull boxes indoors where larger boxes are required. Use cast iron boxes out of doors.

2.3 Boxes sizes shall be as indicated on the drawings, herein specified, per the NEC for the conduit sizes, conductors and situation encountered, or as directed by the Professional. Use above listed outlet box sizing schedule for stamped steel junction/pull boxes.

2.4 All junction or pull boxes shall be labeled indicating system being served, branch circuit or feeder circuit identification, etc. Where installed in concealed locations (i.e. above accessible ceilings) or in unfinished areas, identification shall be made on outside of box cover. Where installed exposed in finished locations, identification shall be made on inside of box cover. Fire alarm system(s) junction box where not exposed in a finished space shall have covers painted “red” in color.

2.5 Close all unused knockout holes in junction/pull boxes and install proper cover. Junction/pull boxes install flush or exposed in finished spaces shall be installed with the same requirements as outlet boxes.

2.6 Junction/pull boxes shall be as manufactured by Hoffman, Columbia, Hope or equal approved by the Professional.

3. PLATES/COVERS

3.1 Provide plates and/or covers on all boxes and outlets with or without devices. Plates shall be single, multi-gang or combination types to match corresponding devices. Securing screws shall have same finish as plate. Oversized or jumbo plates shall not be used without specific approval from the Professional.

3.2 Plates shall be properly secured to outlet box with corners in contact with finished wall and oriented parallel/perpendicular to adjacent building surfaces.

3.3 Plates on all flush mounted boxes/outlets shall be satin-finished, type 302 stainless steel (18% chrome, 8% nickel) as manufactured by Hubbell or equal in Pass & Seymour, Leviton or Arrow Hart.

3.4 All surface mounted outlet/junction boxes shall be provided with galvanized steel plates.

3.5 Weather proof receptacles installed outdoors in locations protected from the weather (roofed open porches, canopies, and the like) or in other indoor damp locations shall be provided with weather proof covers as manufactured by Hubbell or equal in Pass & Seymour, Leviton or Arrow Hart. Plates shall be Cat. No. CWP8H for non-GFI type receptacles and Cat. No. CWP26H for GFI type receptacles. Weather proof receptacles installed outdoors in locations unprotected from the weather shall be provided with “in-use” type weather proof covers as manufactured by Hubbell Cat. No. WP8MHP or equal approved by the Professional.

4. FLOOR BOXES

4.1 Floor boxes shall be provided where shown or noted on the drawings with the configuration shown or noted on the drawings or as required for the devices or outlets to be installed or provided within. The locations for floor boxes shown on the drawings are approximate and representative. The actual location of each floor box shall be verified with the Professional prior to rough-in.

4.2 Floor boxes shall be cast iron where installed in contact with earth or an outdoor environment (crawl space, etc.) or in any concrete unless otherwise noted or specified herein. Floor boxes shall be of the proper depth for the floor construction encountered and complete with all required mounting accessories. Floor boxes installed indoors in raised flooring system or floors of all wood or similar construction may be of galvanized stamped steel construction similar to cast iron boxes specified.

4.3 Floor boxes shall be installed flush with floor finish and have proper flange to cover joint between the edge of the box and the floor finish. All floor boxes shall be adjustable after installation to level the box with the floor finish.

4.4 Floor boxes shall be UL listed for the installation encountered and for the scrub water exclusion test for the type floor finish in which installed.

4.5 Floor boxes shall be the following by listed manufactured or equal in Wiremold, Thomas & Betts/Steel City, Hubbell or equal approved by the Professional.

a. Flush Poke-Thru Type - Floor boxes shall be flush poke-thru type Evolution 6AT Series as manufactured by Wiremold with flange plate assembly of configuration as shown on the drawings or as directed by the Professional. Poke-thru floor boxes shall be U.L. fire rated as required to maintain the fire rating of the floor installed. Standard flange plate color as selected by the Professional. Properly core drill existing floor slabs as required for floor box installation. Provide and connect devices, receptacles, and/or outlets as indicated on drawings to be installed within..

- END OF SECTION 260120 -

260130 LOW-VOLTAGE POWER CONDUCTORS

1. GENERAL

1.1 Conductors shall be standard annealed copper rated 600 volts with mechanical strength, insulation, temperature and current carrying capacity adequate for the particular conditions under which they are used and in accordance with the following:

a. In wet or dry locations type "THHN-THWN" complying with NEMA WC 5 unless specifically shown or noted on drawings or specified herein to be other type.

b. Branch circuit conductors within three (3) inches of a ballast within the ballast compartment of fluorescent luminaires shall be recognized for use at temperatures not lower than 90°C.

c. In un-wired luminaires where required by the NEC, use approved heat-resistant wire sized for current, voltage and temperature at which luminaire operates.

d. Conductors entering the self-contained ballast compartment of gaseous vapor discharge fixtures shall be rated 600 volts, #10 AWG, stranded copper, silicone rubber insulation, glass outer-braid and 200°C. rated conductor temperature.

1.2 Conductor sizes #8 AWG and larger shall be of the stranded type with Class B stranding. Conductor sizes #10 AWG and smaller shall be of the solid type with the exception that all final connections to motors or other vibrating equipment shall be made with stranded conductors regardless of conductor size.

1.3 Use #12 AWG minimum power branch circuit conductor size with exceptions as noted on the drawings or as stated herein. 120 volt branch circuit homerun conductors in excess of 50 feet in length and 277 volt branch circuit homerun conductors in excess of 100 feet in length of all 20 ampere branch circuits shall be #10 AWG minimum size whether or not shown or noted on the drawings.

1.4 All shared neutral conductors of 20 ampere branch circuits serving receptacles shall be #10 AWG minimum.

1.5 Use manufacturer approved pulling compound or lubricant where necessary. Compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage conductors or raceways.

2. CONNECTIONS/SPLICES

2.1 Tighten electrical connections and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

2.2 Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

2.3 Make splices and connections in accessible boxes, gutters or cabinets only. Conductors sizes #8 AWG and larger shall be spliced only with specific approval from the Professional.

2.4 Use soldered and taped or approved mechanical splice connections on solid wire and pressure type solderless connectors well taped on stranded conductors. Conductor sizes #8 AWG and larger shall have irreversible compression type splice.

2.5 Use Scotch 3M or approved equal plastic tape over mechanical and soldered splices applied in thickness equal to wire insulation.

3. COLOR CODING

3.1 Color-code 480/277 volt, 3 phase, four wire, “wye” connected secondary electrical systems service entrance, feeder and branch circuit conductors throughout the secondary electrical system as follows:

Phase A - Brown, Phase B - Orange, Phase C - Yellow
Three-way & four-way travelers - Purple w/Yellow stripe
Neutral - White with continuous colored stripe, Equipment Ground - Green

Color-code 208/120 volt, 3 phase, four wire, “wye” connected secondary electrical systems service entrance, feeder and branch circuit conductors throughout the secondary electrical system as follows:

Phase A - Black, Phase B - Red, Phase C - Blue
Three-way & four-way travelers - Purple
Neutral - White, Equipment Ground - Green

4. TESTING

4.1 Conductor insulation test shall be performed on all electrical service entrance conductors, switchboard/panelboard and transformer feeder conductors and branch circuit conductors #2 AWG and larger. An insulation test shall be performed on any feeder or branch circuit as requested by the Professional for trouble shooting purposes. The “600V Conductor Insulation Test Report” found at the end of this section shall be completed with test results and shall be submitted to the Professional prior to substantial completion of the project.

4.2 600 volt conductor insulation tests shall be performed using a 500 volt megger. Each conductor shall be tested with all splices made but no equipment or devices connected. Feeder/branch circuits with paralleled conductors shall have conductors tested separately prior to paralleling. The ohmic value measured shall be recorded and the results shall meet the minimum requirements of the conductor manufacturer. Conductors not meeting these minimum requirements shall be replaced or repaired as directed by the Professional.

- END OF SECTION 260130 -

# 600V CONDUCTOR INSULATION TEST REPORT

I. Testing Organization

Company Name:_____Test Date:_____

Representative:_____Telephone No.:_____

II. Project Information

Project Name:_____ W/O Job No.:_____

Project Address:_____

III. Test Results

| Circuit Information | | Conductor Information | Test Results (Kilohms) | | | |
|---|---|---|---|---|---|---|
| Source | Load | Number/Size | PH. A | PH. B | PH. C | Neut. |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

(make copies of page as required)

# 260150 BUSWAY SYSTEMS

## A. GENERAL

1. Shall be installed where and as shown on the drawings and in accordance with these specifications complete with all necessary fittings.

2. All material and installation shall comply with all applicable codes, recommended practices and standards of NEC, ANSI, IEEE, NEMA and UL.

## B. HOUSING/ENCLOSURE

1. Housings shall be of extruded aluminum to provide maximum protection against corrosion and shall be of sufficient thickness (min. 1/10") and strength to protect the enclosed buses. Housing shall be coated with durable baked-enamel ANSI-61 grey finish. All hardware shall be plated to prevent corrosion.

2. Housing and bus bars shall be properly braced and the assembly properly rated to withstand without damage or permanent distortion the available short-circuit current at the source connection as noted on the drawings for the busway or the as indicated for the serving over-current protection device.

3. Housing shall include mounting rails which will accept busway mounting provisions along the entire length of the busway.

## C. BUS BARS

1. Bus bars shall be electrolytically tin-plated 98% conductivity copper with ampere rating as indicated on the drawings. Busway shall be constructed such that full ampere rating as indicated is maintained without regard to mounting position. Bus bars shall be suitably plated at all joints and contact surfaces.

2. The maximum hot-spot temperature rise at any point in the busway at continuous rated load shall not exceed 55°C above a maximum ambient temperature of 40°C in any position.

3. All insulation material shall be NEMA Class B epoxy (130°C).

## D. POWER CONNECTIONS

1. Where busway is indicated to be served via a conduit and conductor feeder arrangement, a tap box of same rating as the connected busway with proper configuration and with cable connection lugs shall be provided.

2. Circuit breaker bus plug outlets where shown or noted on the drawings shall be quick-make/quick-break operating switch type and shall have frame sizes as shown on the drawings.

3. Bus-way components shall be the following as manufactured by General Electric Company or equal in Square D Co., Siemens or Eaton:

| | Item | Cat. No. |
|---|---|---|
| a. | Plug-in bus-way, number of poles and size as noted on the drawings w/ground busbar. | Spectra Series |
| b. | Bus plugs, number of poles and size as noted on the drawings, voltage of system, and ground busbar contact. | Circuit breaker operating switch type |

E. MANUFACTURERS

1. Busway System shall be as manufactured by General Electric Spectra Series or equal in Siemens, Square D Company or Cutler Hammer.

- End of Section 260150 -

260250 GROUNDING & BONDING SYSTEM

1. GENERAL

1.1 Bonding and grounding of all electrical equipment, enclosures, raceways, etc. as shown on the drawings and in strict accordance with Article 250 of the NEC.

2. WIRING DEVICES

2.1 Equipment grounding terminal (green) of all grounding type receptacles/devices shall be bonded to the equipment grounding conductor and to the device's enclosure with a properly sized bonding conductor (green) unless the receptacle/device is approved and listed for self-bonding.

3. RACEWAYS, BOXES & ENCLOSURES

3.1 Pull into all power branch circuit and feeder raceways one green equipment grounding conductor of the same size as the branch circuit conductors or size as noted on the drawings and bond this conductor to the box ground terminal, receptacle/device ground terminal (green), equipment grounding bus of panelboard, cabinet and/or enclosures.

3.2 Where conduits in excess of 1-1/4" trade size and all feeder conduits enter an enclosure, box, etc. provide grounding bushing or bronze ground clamps with bonding conductors sized per the NEC (#10 AWG minimum) connected to all ground bushings/clamps and thence to equipment enclosure and/or equipment grounding bus.

3.3 Couple conduits together and connect to boxes, fittings and enclosures so as to provide effective electrical continuity. Assure ground continuity on GRS feeder and branch circuits by two locknuts, one inside and one outside of all boxes, cabinets and gutters. Do not use couplings dependent on screws bearing on conduit.

4. GROUND RODS

4.1 Ground rods shall be 3/4" x 10'-0" copper-clad sectional, solid rods. Ground rods shall be installed with top a minimum of 12" below the finish grade. All connections to ground rods shall be made by exothermic weld(s).

5. ELECTRICAL SERVICE ENTRANCE

5.1 Bonding and grounding of the electrical service equipment enclosures, raceways and other non-current carrying metal parts shall be in accordance with Article 250 of the NEC. All sections, cubicles and conduits associated with the electrical service entrance equipment shall be bonded together and bonded to the grounded (neutral) with a #6 AWG bare copper equipment grounding conductor.

5.2 The electrical service entrance equipment grounded (neutral) bus and equipment grounding bus shall be bonded together with a main bonding jumper (MBJ) of the same size as the grounding electrode conductor (GEC) herein specified. The grounded (neutral) conductor and the equipment grounding conductors shall not be bonded together at any other location in the system except at separately derived systems as defined by the NEC.

5.3 The grounding electrode system shall consist of driven ground rods, the incoming metallic cold water pipe where present and of the proper characteristics and the building structural steel where present. Where multiple ground rods are necessary, indicated or required, they shall be installed in a straight line or triangular pattern such that each ground rod is a minimum of six (6) feet from any adjacent ground rod or other type of grounding electrode. The connection of the grounding electrode conductor to the incoming metallic underground water pipe shall be made within five (5) feet of the pipe's point of entry into the building and shall be accessible.

5.4 The grounding electrode conductor (GEC) shall be bare copper sized as indicated on the drawings or per Table 250.66 of Article 250 of the NEC whichever size is largest. The grounding electrode conductor shall run continuous without splices and utilizing the most direct path from the electrical service entrance equipment's grounded (neutral) bus to each grounding electrode. The grounding electrode conductor shall be routed in electrical grade rigid PVC conduit to the point of connection to the grounding electrode system and/or to a point a minimum of 12" below the finished grade. All connections of the grounding electrode conductor to the grounding electrodes shall be made by exothermic weld(s).

5.5 A grounding bus bar shall be provided adjacent to the electrical service entrance equipment and at an accessible location for the purpose of grounding/bonding ancillary systems in the building/facility. The grounding bus bar shall be copper of minimum dimensions 20"X4"X1/4" with wall mounting bracket with insulators to isolate the ground bar. The ground bar shall have pre-drilled termination holes of proper size for lugs properly spaced over the entire length and width of the bar to terminate #12 through #4 AWG copper wire. The grounding bus bar shall be connected to the grounded (neutral) bus of the electrical service entrance equipment using a bare copper conductor of same size as the grounding electrode conductor. The grounding bus bar shall be properly labeled as to its function.

5.6 The grounding electrode system shall consist of the proper number of grounding electrodes properly connected per the NEC to limit the resistance to ground of the grounding electrode system to a maximum of 25 ohms. The resistance to ground of the installed grounding electrode system shall be verified using a ground tester.

5.7 All metallic piping systems (water, natural gas, fire protection, etc.) within or attached to the building(s) and the building's structural steel shall be bonded to the grounding electrode system in accordance with Article 250 of the NEC. Where a lightning protection system is provided or exist on the building(s), the lightning protection system's grounding electrode system shall be bonded to the electrical service grounding electrode system.

6. SEPARATELY DERIVED SYSTEMS

6.1 An equipment grounding conductor shall be provided from the source equipment's ground bus to the equipment grounding bus or enclosure of all separately derived systems (i.e. dry-type transformers, engine generators, etc.).

6.2 The grounded (neutral) bus of each separately derived system shall be bonded to the equipment grounding bus or conductor by a main bonding jumper. The bonding of the grounded (neutral) bus and the equipment grounding bus shall occur within the equipment's enclosure at the connection terminals of each bus. The grounded (neutral) bus shall be connected to the nearest grounding electrode by a grounding electrode conductor. The grounding electrode may be the building's structural steel where effectively grounded and bonded to the electrical service entrance grounding electrode system, the incoming metallic water pipe where the connection can be made within five (5) feet of the pipes entry into the building and/or the building's electrical service grounding electrode system.

6.3 The grounding electrode conductor and the main bonding jumper of each separately derived system shall be bare copper sized as indicated on the drawings or per Table 250.66 of Article 250 of the NEC whichever size is largest. The grounding electrode conductor shall run continuous without splices and utilizing the most direct path from the separately derived system's grounded (neutral) bus to the grounding electrode(s). The grounding electrode conductor shall be routed in electrical grade rigid PVC conduit to the point of connection to the grounding electrode system. All connections of the grounding electrode conductor to the grounding electrodes shall be made by exothermic weld(s).

6.4 All metallic piping systems (water, natural gas, fire protection, etc.) located within the area served by the separately derived system shall be bonded to the separately derived system's grounding electrode system in accordance with Article 250 of the NEC.

END OF SECTION

260310 PANELBOARDS

A. BRANCH CIRCUIT PANELBOARDS

1. GENERAL

1.1 Commercial grade branch circuit panelboards complete with feeders, circuit breakers and branch circuits as scheduled and/or shown on the drawings. Where shown on the drawings to be service entrance equipment, panelboards shall be specifically approved for that purpose and shall have all required accessories.

1.2 Branch circuit homerun conductors shall be connected to circuit breakers served from separate phase busses of the panelboards. Loads shall be properly balanced on each phase. Only one conductor shall be connected to a lug and/or terminal.

1.3 Panelboards and components shall be manufactured in accordance with applicable NEMA standards and the NEC and shall be UL listed. Installation and connection of all panelboards shall comply with the NEC and their UL listing.

1.4 Bonding and grounding in accordance with Section 260250 "GROUNDING AND BONDING SYSTEMS" of this specification.

2. ENCLOSURES/MOUNTING

2.1 Panelboards shall be dead front construction with solderless pressure terminals. Enclosures shall be for surface or flush mounting as shown or noted on the drawings and rated NEMA 1 for dry indoor installations or NEMA 3R for outdoor or wet indoor installations. Panelboards shall be provided with trim and door with lock and catch with two (2) keys. Keys shall be common to all new building panelboards.

2.2 Panelboards shall be securely mounted with through bolts, anchors or other approved means to building structural elements (i.e. metal/wood studs, concrete block, etc.). Contractor shall provide required cross bracing between building structural elements and/or proper mounting surface and structure if wall is of insufficient strength. All wood or other flammable mounting surfaces shall be painted with two coats of flame resistant paint. Mount panelboards with top breaker handle not more than 6'-6" above floor. Installation of flush panelboards shall not compromise the fire rating of walls.

2.3 Panelboard installations shall provide and maintain working space clearances and dedicated electrical equipment spaces as required by Article 110 of the NEC.

2.4 Flush mounted panelboards shall have a minimum of four (4) spare 3/4" conduits stubbed up above the nearest accessible ceiling location for future use.

3. BUSES

3.1 Main and neutral buses of capacity as shown on the drawings shall be completely tin and/or silver plated copper or electrical grade aluminum completely tin plated.

3.2 Provide equipment grounding bus(es) of proper ampere rating and with adequate termination points for feeder and branch circuit ground conductors. Equipment grounding bus(es) shall be properly bonded to panelboard enclosure.

3.3 Neutral and equipment grounding busses shall have proper number of terminals for the available panelboard circuits. Only one conductor shall be connected to a lug and/or terminal

3.4 Panelboards required to have feed-through lugs shall have mechanical type lugs suitable for the conductors used located at the opposite end of the bus from incoming feed lugs or main device.

3.5 Where panelboards are shown to be service entrance equipment, the panelboards shall be provided with a main bonding jumper (bus) between the grounded (neutral) bus and the equipment grounding bus of the panelboard. This busing shall be installed by the manufacturer.

4. CIRCUIT BREAKERS

4.1 Circuit breakers shall be molded case, thermal magnetic type with bolted connections and characteristics as shown on the drawings including ampere and voltage ratings, minimum interrupt rating (KAIC) and accessories as shown on the drawings or herein specified. Circuit breaker fault current interrupt capacities shall be fully rated. Series ratings are not acceptable.

4.2 All single pole 15 and 20 ampere circuit breakers shall be UL listed SWD for switching duty. All circuit breakers serving HVAC equipment shall be UL rated HACR. All 15 and 20 amp circuit breakers serving high magnetic (HM) or high intensity discharge (HID) loads shall be HM or HID rated, respectively.

4.3 Panelboards served from the secondary side of a dry-type transformer constituting a separately derived system shall be provided with a main circuit breaker sized as shown on the drawings or per the NEC if size not indicated.

4.4 Branch circuit breakers serving receptacles or equipment located under a kitchen range/exhaust hood equipped with at fire suppression system shall be the shunt-trip type controlled by the fire suppression system control panel. All circuitry (conduit and wiring) required for the interface of these systems shall be provided.

4.5 Branch circuit breakers serving elevator motors shall be the shunt-trip type controlled by the building Fire Detection and Alarm System or the Fire Protection System as shown or noted on the drawings. All circuitry (conduit and wiring) required for the interface of these systems shall be provided.

5. IDENTIFICATION/LABELING

5.1 Provide complete typewritten directory with transparent plastic cover inside of panelboard door. Panelboard designation as indicated on the drawings shall be identified by 3/4" bakelite label, white with minimum 1/2" high, black engraved letters on front face if the panelboard is surface mounted or inside of door if panelboard is flush mounted. Typed copy of each panelboard circuit directory shall be submitted with shop drawing submittal for approval.

5.2 Branch circuit panelboard circuits shall be numbered in sequence vertically down the left side then vertically down the right side and all circuits shall be provided in the panelboard exactly as they are shown on the drawings. Numbering to be consecutive for double or triple section panelboards. Neutral connections shall be identified by adhesive number tags to identify with their associated branch circuit phase conductors.

6. MANUFACTURERS

6.1 Panelboard(s) with characteristics as shown on the drawings, herein specified, and as manufactured by General Electric Types AQ, AE, AD and/or Spectra Series or equal in Siemens, Square D Company or Cutler Hammer.

7. EXISTING PANELBOARDS

7.1 Where existing panelboard(s) is/are shown and/or noted to be used for new branch circuits, existing adequate spare circuit breakers and/or spaces may be used for the new circuits. Circuit breaker(s) installed in existing panelboards shall be of the same manufacturer and KAIC rating as existing breakers. Where space is inadequate for new circuit breaker(s), provide new panelboard section with sufficient pole capacity and same ratings as existing panelboard and serve by tapping the bus of the existing panelboard. Provide all required hardware and accessories necessary for installation of the new circuit breaker(s) and/or panelboard sections. Contractor shall be responsible for visiting the site and verifying the existing conditions prior to bidding.

B. <u>DISTRIBUTION PANELBOARDS</u>

1. GENERAL

1.1 Commercial grade distribution panelboard(s) complete with feeders, feeder/branch circuit breakers and feeder/branch circuits as shown on the drawings. Where shown on the drawings to be service entrance equipment, panelboard shall be specifically approved for that purpose and shall have all required accessories.

1.2 Panelboards and components shall be manufactured in accordance with applicable NEMA standards and the NEC and shall be UL listed. Installation and connection of all panelboards shall comply with the NEC and their UL listing.

1.3 Provide grounding bushings on all raceways entering panelboard. Bushings shall be insulating type equal to O-Z/Gedney type “BLG” or equal approved by the Professional.

1.4 Bonding and grounding in accordance with Section 260250 "GROUNDING AND BONDING SYSTEMS" of this specification.

2. ENCLOSURES/MOUNTING

2.1 Panelboards shall be dead front construction with solderless pressure terminals. Enclosures shall be for surface or flush mounting as shown or noted on the drawings and rated NEMA 1 for dry indoor installations or NEMA 3R for outdoor or wet indoor installations. Cabinets shall be code gauge steel with trim and door with lock and catch and two (2) keys common to all building panelboards.

2.2 Panelboards shall be securely mounted with through bolts, anchors or other approved means. Contractor shall provide proper mounting surface if wall of insufficient strength. All wood or other flammable mounting surfaces shall be painted with two coats of flame resistant paint. Mount panelboards with top breaker handle not more than 6'-6" above floor. Installation of flush panelboards shall not compromise the fire rating of walls.

2.3 Panelboard installations shall provide and maintain working space clearances and dedicated electrical equipment spaces as required by Article 110 of the NEC.

2.4 Flush mounted distribution panelboards shall have spare conduit(s) routed to accessible ceiling location for each spare circuit breaker provided properly sized for a four conductor feeder and associated grounding conductor of the same ampere rating as the associated spare circuit breaker.

3. BUSES

3.1 Main and neutral buses of capacity as shown on the drawings shall be completely tin and/or silver plated copper or electrical grade aluminum completely tin plated.

3.2 Provide equipment grounding bus(es) of proper ampere rating and with adequate termination points for feeder and branch circuit ground conductors. Equipment grounding bus(es) shall be properly bonded to panelboard enclosure.

3.3 Neutral and equipment grounding busses shall have proper number of terminals for the available panelboard circuits. Only one conductor shall be connected to a lug and/or terminal.

3.4 Where panelboards are shown to be service entrance equipment, the panelboards shall be provided with a main bonding jumper (bus) between the grounded (neutral) bus and the equipment grounding bus of the panelboard. This busing shall be installed by the manufacturer.

4. CIRCUIT BREAKERS

4.1 Circuit breaker type distribution panelboard with quick-make/quick-break molded case, thermal magnetic type circuit breakers with frame sizes and characteristics as shown on the drawings including ampere and voltage ratings, minimum interrupt rating (KAIC) and accessories as shown or herein specified. Circuit breaker fault current interrupt capacities shall be fully rated. Series ratings are not acceptable.

4.2 Panelboards served from the secondary side of a dry-type transformer constituting a separately derived system shall be provided with a main circuit breaker sized as shown on the drawings or per the NEC if size not indicated.

4.3 Branch circuit breakers serving receptacles or equipment located under a kitchen range/exhaust hood equipped with at fire suppression system shall be the shunt-trip type controlled by the fire suppression system control panel. All circuitry (conduit and wiring) required for the interface of these systems shall be provided.

4.4 Branch circuit breakers serving elevator motors shall be the shunt-trip type controlled by the building Fire Detection and Alarm System or the Fire Protection System as shown or noted on the drawings. All circuitry (conduit and wiring) required for the interface of these systems shall be provided.

5. IDENTIFICATION /LABELING

5.1 Each circuit breaker shall be labeled as to load served by 1/2" bakelite label, white with minimum 1/4" high, black engraved letters. Panelboard designation as indicated on drawings shall be identified by 3/4" bakelite label, white with minimum 1/2" high, black engraved letters on front face if the panelboard is surface mounted or inside of door if panelboard is flush mounted.

5.2 Branch/feeder circuit breakers shall be arranged in the panelboard as shown on the drawings where possible. Circuit breaker arrangement may be modified to facilitate the installation and connection of feeders or as required to comply with the panelboard manufacturer’s circuit breaker arrangement limitations. Whenever modifications to the circuit breaker arrangement are made, the associated panelboard shop drawing shall indicated the load designation as well as the circuit breaker size on the panelboard cut sheet.

6. MANUFACTURERS

6.1 Distribution Panelboard(s) with characteristics as shown on the drawings, herein specified, and as manufactured by General Electric Spectra Series or equal in Siemens, Square D Company or Cutler Hammer.

7. EXISTING DISTRIBUTION PANELBOARDS

7.1 Where existing panelboard(s) is/are shown and/or noted to be used for new feeder(s) and/or branch circuit(s), existing adequate spaces may be used for the new circuit breakers(s). Circuit breakers installed in existing panelboards shall be of the same manufacturer and KAIC rating as existing breakers. Where available space is inadequate for new circuit breaker(s), provide new panelboard section or breaker enclosure and serve by tapping the bus of the existing panelboards, provide all required hardware and accessories necessary for the installation of the new circuit breaker(s) and/or enclosures. Contractor shall be responsible for visiting the site and verifying the exiting conditions prior to bidding.

- END OF SECTION 260310 -

260350 DRY-TYPE TRANSFORMERS

1. GENERAL

1.1 Low voltage distribution system(s) shall be provided by means of energy efficient dry-type general purpose transformers designed for continuous operation. Transformers shall be provided and connected where shown on the drawings and in accordance with these specifications, the NEC and the manufacturer's recommendations.

1.2 Dry-type transformers shall be three phase, 60Hz, connected 480 volts "delta" on the primary and 208/120 volts "wye" on the secondary unless otherwise shown or noted on the drawings.

1.3 Final electrical connection to both primary and secondary of dry-type transformers shall be liquid-tight flexible metallic conduit with proper fittings. Connections to transformer housing shall be through sides near bottom of transformer at manufacturer's allocated connection spaces.

1.4 Transformers shall be constructed in accordance with NEMA ST-20 and ANSI C89.2. Sound levels for dry-type transformers shall conform to the latest recommendations of ASA and NEMA standards.

1.5 Transformers shall be grounded and bonded as separately derived systems unless noted otherwise in accordance with Section 260250 of this specification and Article 250 of the NEC.

2. ENCLOSURE/MOUNTING

2.1 Shall be enclosed in a NEMA 2 drip-proof metal enclosure with natural draft ventilation. Core and coil assemblies shall be mounted on rubber isolation pads to minimize sound levels.

2.2 Sizes 15KVA and larger shall be wall or floor mounted unless otherwise indicated on the drawings. Install level and plumb. A neoprene isolation pad shall be provided between transformer and the structure in which mounted. Mount transformers such that minimum clear space from walls, equipment, etc. on all sides as recommended by the manufacturer is maintained for cooling.

2.3 Support of suspended transformers shall be from the building structure on proper angle iron mounting frames to support the transformer's weight. Minimum frame shall be 3"X3"X1/4" welded angle iron with a minimum of four (4) 1/2" rods securely and safely anchored to the building structure. Mount transformers such that minimum clear space from walls, equipment, etc. on all sides as recommended by the manufacturer is maintained for cooling.

2.4 Dry-type transformers shown or noted on the drawings to be installed out-of-doors shall be provided with all necessary accessories to provide a NEMA 3R rated and tamper resistant enclosure.

2.5 Where shown or noted on the drawings, dry-type transformers shall be totally enclosed non-ventilated (TENV) type for continuous operation in a 40 degree C ambient with a temperature rise not to exceed 150 degrees C.

3. STANDARD TRANSFORMERS

3.1 Coil windings shall be constructed of aluminum or copper conductors. Transformers shall be self-cooled, with NEMA Class H insulation and shall be vacuum-impregnated for protection against moisture and airborne contaminants. Transformers shall be for continuous operation in a 40 degree C ambient with a temperature rise not to exceed 150 degree C.

3.2 Transformers shall have two (2) 2-1/2% taps above and below nominal rated primary voltage. Taps shall be fully rated.

3.3 One core per phase and constructed of high-grade, non-aging, grain oriented, silicon steel with low hysteresis and eddy current losses.

4. K-RATED STANDARD TRANSFORMERS

4.1 Where shown or noted on the drawings, dry-type transformers shall be UL rated K-13 for use with non-linear electrical loads.

4.2 Coil windings shall be constructed of aluminum or copper conductors. Insulation material shall be NEMA Class H and shall be vacuum-impregnated for protection against moisture and airborne contaminants. Transformers shall be for continuous operation in a 40 degree C ambient with a temperature rise not to exceed 115 degree C.

4.3 K-rated transformers shall have two (2) 2-1/2% taps above and below nominal rated primary voltage. Taps shall be fully rated.

4.4 One core per phase and constructed of high-grade, non-aging, grain oriented, silicon steel with low hysteresis and eddy current losses.

5. MANUFACTURERS

5.1 Dry-type transformers shall be as manufactured by General Electric or equal in Siemens, Square D Co. or Cutler Hammer.

- END OF SECTION 260350 -

260410 WIRING DEVICES

1. WALL SWITCHES (Line Voltage)

1.1 Wall switches shall be flush A.C. tumbler-type, back and side wired, and shall be installed to cut ungrounded conductors. Conductors shall be connected using side wired screw terminals.

1.2 Shall be ganged together under one non-sectionalized plate in gangable boxes where two or more switches occur at one point. Provide metal barrier within box between all adjacent switches served by circuit conductors of different phases or conductors of a different system.

1.3 Shall be mounted 48" above finished floor to center of operating handle or as noted on the drawings. Mounting heights may be adjusted slightly to permit cutting of masonry block to the top or bottom of the block course nearest the specified height. All mounting heights shall be consistently cut above or below block coursing such that switches will be the same height above the finished floor.

1.4 Wall switches shown at door ways shall be mounted adjacent to door ways on opposite side of door from hinges unless prohibited by wall space. Where switches must be mounted on same side of door as hinges, mount switches so as not to be located behind the opened door. First switch of single or ganged switch bank shall be mounted within 12" of door frame and/or edge of door.

1.5 Wall switches shall be the following heavy-duty specification grade as manufactured by Hubbell or approved equal in Pass and Seymour (P&S), Leviton or Arrow Hart. Contractor shall verify device color with Professional prior to ordering devices.

Single pole, 20A, 120/277V: Hubbell Cat. No. HBL1221, P&S Cat. No. PS20AC1, Leviton Cat. No. 1221-2.

Three-way, 20A, 120/277V: Hubbell Cat. No. HBL1223, P&S Cat. No. PS20AC3, Leviton Cat. No. 1223-2.

Four-way, 20A, 120/277V: Hubbell Cat. No. HBL1224, P&S Cat. No. PS20AC4, Leviton Cat. No. 1224-2.

2. WALL-BOX DIMMERS (Line Voltage)

2.1 Shall be flush AC type, modular, full wave, solid state units with quiet on/off switch and audible frequency and EMI/RFI filters. Shall be U.L. 20 and U.L. 1472 listed specifically for the connected lighting source as shown on the drawings (incandescent, fluorescent or magnetic low-voltage).

2.2 Wall-box dimmers used with fluorescent lighting sources shall be fully compatible with the fluorescent ballast installed in the luminaires to be controlled. Division 26 Contractor is fully responsible for coordinating the compatibility of the dimmers and ballasts.

2.3 Shall incorporate an air gap switch and control shall be linear slide. Shall provide a smooth and continuous square law dimming curve. Shall be single-pole or three-way as required by connections shown on the drawings.

2.4 Dimmers and switches shall meet ANSI/IEEE Standard C62.41 latest edition and shall be capable of withstanding without damage voltage surges up to 6000V and current surges up to 200A.

2.5 Shall have the proper wattage rating as shown or noted on the drawings or as required for the load involved. Where multiple dimmers are installed at a location, care should be taken to provide a neat and orderly layout. Dimmer shall not be ganged together in a manner that derates the listed wattage capacity(ies).

2.6 Shall be mounted 48" above finished floor to center of operating handle, as noted on the drawings or at same height as adjacent wall switches. Mounting heights may be adjusted slightly to permit cutting of masonry block to the top or bottom of the block course nearest the specified height. All mounting heights shall be consistently cut above or below block coursing such that dimmers and switches will be the same height above the finished floor.

2.7 Wall-box dimmers shown at door ways shall be mounted adjacent to door ways on opposite side of door from hinges unless prohibited by wall space. Where dimmers must be mounted on same side of door as hinges, mount dimmers so as not to be located behind opened door. First switch or dimmer of single or ganged switch bank shall be mounted within 12" of door frame and/or edge of door.

2.8 Wall-box dimmers shall be the following as manufactured by Lutron or approved equal in Leviton or Pass and Seymour (P&S). Contractor shall verify device color with Professional prior to ordering devices.

LED wall-box dimmer: Lutron “NOVA T” Series or equal in Leviton, Pass & Seymour, Hubbell. LED dimmers shall be fully compatible with supplied drivers for connected LED lighting fixtures.

3. OCCUPANCY SENSORS

3.1 Occupancy sensors shall be rated for the load connected (incandescent, fluorescent, etc.) and shall be wall-box or wall/ceiling mounted device(s) as shown or noted on the drawings. Devices shall be located per the manufacturer’s recommendations to provide maximum coverage for the installed space. Division 26 Contractor is responsible for all adjustments and final settings of devices for proper operation.

3.2 Wall-box sensors shall be mounted 48" above finished floor to center of the device, as noted on the drawings or at same height as wall switches. Mounting heights may be adjusted slightly to permit cutting of masonry block to the top or bottom of the block course nearest the specified height. All mounting heights shall be consistently cut above or below block coursing such that switches will be the same height above the finished floor.

3.3 Wall-box sensors shown at door ways shall be mounted adjacent to door ways on opposite side of door from hinges unless prohibited by wall space. Where devices must be mounted on same side of door as hinges, mount so as not to be located behind the opened door. Device shall be mounted within 12" of door frame and/or edge of door.

3.4 Ceiling mounted units shall receive control power from a separately mounted auxiliary power and control unit (power pack). The occupancy sensor shall control the operation of the power switching contacts in the power pack.

3.5 Shall turn lighting luminaires “on” when room/space is occupied and “off” when unoccupied unless otherwise indicated on the drawings. Sensor location, aiming and adjustment shall insure that lighting turns “on” immediately as occupants enter room/space from all entrances. Shall have field adjustable “off” delay of 1 to 15 minutes minimum.

3.6 Occupancy sensors shall be the following as manufactured by Leviton or approved equal in WattStopperl or Unenco. Contractor shall verify device color with Professional prior to ordering devices.

Wall-box occupancy sensor, passive infrared, 180 degree X 2100 s.f., with manual on/off override switch: Leviton Cat. No. ODS15-ID or equal in WattStopper, Sensor Switch or Unenco.

Occupancy Sensor, ceiling mount, multi-technology type (infrared/ultrasonic), 360 degree X 2000 s.f., with power pack: Leviton Cat. No. OSC20-M0W-ODP or equal in WattStopper, Sensor Switch or Unenco.

Occupancy Sensor, ceiling mount, multi-technology type (infrared/ultrasonic), 180 degree X 500 s.f., with power pack: Leviton Cat. No. OSC05-M0W-ODP or equal in WattStopper, Sensor Switch or Unenco.

Occupancy Sensor, ceiling mount, ultrasonic type, 360 degree X 2000 s.f., with power pack: Leviton Cat. No. OSC20-U0W-ODP or equal in WattStopper, Sensor Switch or Unenco.

Occupancy Sensor, ceiling mount, ultrasonic type, 180 degree X 1000 s.f., with power pack: Leviton Cat. No. OSC05-U0W-ODP or equal in WattStopper, Sensor Switch Unenco.

Occupancy Sensor, ceiling mount, passive infrared, 360 degree, 360 degree X 1500 s.f., with power pack: Leviton Cat. No. OSC15-I0W-ODP or equal in WattStopper, Sensor Switch or Unenco.

Occupancy Sensor, wall mount, multi-technology type (infrared/ultrasonic), 115 degree X 1200 s.f., with power pack: Leviton Cat. No. OSW12-M0W-ODP or equal in WattStopper, Sensor Switch or Unenco.

4. POWER RECEPTACLES

4.1 All convenience receptacles shall be specification or industrial grade as listed, straight blade type, 2 pole 3 wire grounding, back and side wired with nylon face. Conductors shall be connected using side wired screw terminals.

4.2 Convenience outlets and receptacles shall be mounted center line up 16" above finished floor unless shown or noted on the drawings otherwise. Convenience outlets and receptacles located at counters shall be mounted center line up 4" above counter top or backsplash unless shown or noted on the drawings otherwise. Mounting heights may be adjusted slightly to permit cutting of masonry block to the top or bottom of the block course maintaining the minimum specified height. All mounting heights shall be consistently cut above or below block coursing such that receptacles/outlets will be mounted the same height above the finished floor. Adjacent devices to be mounted at same height unless otherwise directed.

4.3 Carefully review Architectural, Furniture and Interior Design drawings for furniture, casework or millwork. Do not rough-in receptacles behind equipment, millwork, etc. except where specifically noted. Where receptacle is shown behind equipment, verify proper mounting height with the Professional prior to rough-in.

4.4 Where receptacles serve equipment (i.e. refrigerators, ranges, dishwashers, ice makers, etc.) intended to be installed flush with the adjacent millwork, walls, etc., receptacle locations and mounting heights shall be fully coordinated with the supplied equipment shop drawings so that neither the receptacle nor the associated cord and plug connection interferes with the correct placement of the equipment.

4.5 Convenience outlets and receptacles as manufactured by Hubbell, as stated or equal in Pass and Seymour (P&S), Leviton or Arrow Hart. Contractor shall verify device color with Professional prior to ordering devices.

Duplex grounding receptacle (HD specification grade), 20A, 125V: Hubbell Cat. No. HBL5352, P&S Cat. No. 5362, Leviton Cat. No. 5362-S.

Duplex grounding receptacle, ground fault interrupter type (HD specification grade), 20A, 125V: Hubbell Cat. No. GF5352, P&S Cat. No. 2091, Leviton Cat. No. 8899.

Duplex grounding receptacle (HD specification grade), 20A, 125V, weatherproof: Hubbell Cat. No. HBL5352, P&S Cat. No. 5362, Arrow Hart Cat. No. 5362, Leviton Cat. No. 5362-S. Plates shall be equal to Hubbell Cat. No. 5206WO or Cat. No. WP8MHP for permanent or “in-use” outdoor cord and plug connections.

Duplex grounding receptacle, weatherproof, ground fault interrupter type (HD specification grade), 20A, 125V: Hubbell Cat. No. GF5352, P&S Cat. No. 2091, Arrow Hart Cat. No. GF5342, Leviton Cat. No. 6899. Plates shall be equal to Hubbell Cat. No. 5206WO or Cat. No. WP8MHP for permanent or “in-use” outdoor cord and plug connections.

4.6 Special purpose receptacles shall have voltage, phase and ampere ratings as indicated on the drawings and of proper NEMA configuration. Each receptacle shall be HD specification grade. Special receptacles for power connection of equipment shall have proper NEMA configuration for equipment served and equipped with proper plug completely installed.

4.7 Where receptacles are indicated to be twist lock type, each shall be industrial or HD specification grade as specified herein for similar straight blade type receptacles and of proper NEMA configuration for the equipment served and shall have proper NEMA configured plug furnished.

5. SAFETY SWITCHES

5.1 Safety switches shall be heavy-duty type as defined by NEMA, fusible or non-fusible as indicated on the drawings and shall be rated for the voltage of the circuit in which installed. Switches shall have the proper number of poles as indicated on the drawings or as required for the phase characteristics of the circuit in which installed. A ground lug shall be provided in all safety switches.

5.2 Safety switches shall have proper NEMA rated enclosure for the environment and conditions in which installed per the NEC and per the following:

a. Indoor dry locations - NEMA 1
b. Indoor wet locations - NEMA 3R
c. Kitchen areas - NEMA 4X
d. Outdoor locations - NEMA 3R
e. Corrosive indoor/outdoor locations - NEMA 4X

5.3 Where safety switches are indicated to be fusible, they shall have dual element, time delay fuses installed as manufactured by Bussman Fusetron Series or approved equal with proper voltage rating for the associated circuit and current size as indicated or as required for the connected equipment.

5.4 Where installed indoors, surface mount safety switches 54" to center of operating handle above the finished floor. Where installed out-of-doors on exterior walls, surface mount safety switches 36" to center of operating handle above the finished grade. Where installed out-of-doors and behind equipment screen walls, surface mount safety switches with top of switch enclosure 6" below top of screen wall and bottom of enclosure a minimum of 18" above the finished grade or slab.

5.5 Where power connections are made out-of-doors through safety switches and where there is no wall or proper equipment frames to which the switches may be mounted, Contractor shall furnish and install a galvanized angle iron frame independent of the equipment for the support of the switch(es). Frames shall consist of the steel frame sufficient to support all of the switches and a concrete footing not less than 12 inches deep and of sufficient width to assure that 4 inches of concrete surround all of the framing members.

5.6 Safety switches shall be installed such that they are readily accessible as defined by the NEC with a clear and unobstructed path thereto. Fully coordinate safety switch mounting locations prior to rough-in with other trades to insure accessibility.

5.7 Each safety switch shall be label on the face of the enclosure door as to the load connected. The label nomenclature shall read the same as the connected equipment label provided. The exterior label shall be suitable for the environment in which installed and shall be self-adhesive, 1/2" bakelite label, white with minimum 1/4" high, black engraved letters. On the interior side of the safety switch enclosure door, permanently label using a self-adhesive printed label the connected load designation, the serving panelboard designation and the serving branch circuit number designation.

5.8 Safety switches shall be the following as manufactured by the Square D Company or equal in General Electric, Siemens, Cutler Hammer or Allen Bradley.

| | |
|---|---|
| Safety switch, heavy-duty, with ground lug | H200-H300 Series |
| Manual motor switch, single pole | Class 2510, Type FO-1 |
| Manual motor switch, double pole | Class 2510, Type FO-2 |

- END OF SECTION 260410 -

# 260420 LIGHTING LUMINAIRES

## A. INTERIOR LIGHTING LUMINAIRES

### 1. GENERAL

1.1 Provide and connect all luminaires as shown on the drawings by symbols and as defined in the luminaire schedule(s). Luminaires shall be provided with all necessary mounting accessories. The installation of all luminaires shall be complete, safe and in full accordance with manufacturer's recommendations and these specifications. This contractor shall provide additional 1-1/2" x 1-1/2" x 12 ga. channel bridging where necessary to mount luminaires governed by the conditions encountered.

1.2 Substituted luminaires shall meet the performance and functional characteristics and the general appearance and dimensions (+/-10%) of the specified luminaires. Approval of submitted substitute luminaire(s) shall not eliminate the Contractor's responsibility to provide luminaires similar in characteristics to the specified luminaire(s).

1.3 The catalog numbers of recessed luminaires, where applicable, are for use in an exposed grid suspension type ceiling system. The Contractor is responsible for providing luminaires with the proper hardware and/or accessories for installation in the ceiling type encountered.

1.4 The lighting luminaire locations shown on the Electrical drawings are approximate and representative. Contractor shall refer to and coordinate with the Architectural reflected ceiling plans and elevation drawings for exact lighting luminaire mounting heights and locations.

1.5 See Section 260100 "Basic Materials & Methods" for additional requirements for hazardous locations and seismic areas.

### 2. INSTALLATION/MOUNTING

2.1 Luminaries mounted level, plumb and square with ceiling and walls with bottom edge above finished floor as indicated on the drawings unless specifically noted otherwise. Luminaires shall be properly secured according to manufacturer's recommendations.

2.2 Luminaire mounting shall be rigid and independent of the ceiling tile(s) and shall be supported from the major structural elements of the ceiling system. Luminaires mounted to concrete shall be anchored with concrete inserts or other means of similar strength as approved by the Professional.

2.3 Mounting of recessed luminaries shall be in accordance with Article 410 of the NEC. Luminaires installed in suspended ceiling systems shall be securely fastened to the ceiling framing members by mechanical means. Recessed fluorescent luminaires requiring a ceiling opening in excess of nine (9) square feet shall be supported independent of the ceiling system.

2.4 All recessed luminaires in accessible ceilings shall be connected with 1/2" flexible conduit from accessible junction box with sufficient length to allow luminaire to be relocated to any adjacent ceiling panel without disconnecting. 3/8" flexible conduit may be used if furnished with the luminaire by the manufacturer. All recessed luminaires in non-accessible ceilings, unless otherwise indicated, shall be pre-wired from the factory with junction box for terminating branch circuit conduit.

2.5 Recessed luminaires shall be installed to properly coordinate with and maintain the fire rating of the ceiling in which installed. Where fire rating installation requires covering over luminaire housing, ballast(s) of proper temperature rating as recommended by the manufacturer shall be furnished.

2.6 Surface luminaires mounted on combustible ceilings or low density acoustical tile ceilings shall be UL approved for such mounting. Surface luminaires mounted on LAT ceilings shall be supported from and properly secured to the ceiling framing members and connected via flexible conduit similar to recessed luminaires. Where surface luminaires are served by exposed raceway, luminaires shall have surface conduit collar furnished by the luminaire manufacturer.

2.7 The lighting luminaire locations shown on the Electrical drawings are approximate and representative. The Contractor shall review the Architectural reflected ceiling plans, elevation drawings, etc. for exact locations and mounting heights of lighting luminaires and for other elements which may effect luminaire mounting and/or operation. Mounting heights of all wall mounted luminaires shall be fully coordinated with the Professional prior to rough-in.

3. LUMINAIRES

3.1 Procure luminaires completely factory wired for proper operation in the application shown on the drawings. All luminaires shall be furnished with proper fittings and accessories for installation in the area encountered. This Contractor shall review the Architectural plans and specifications and provide luminaires compatible with the ceiling specified in each area.

3.2 Lighting luminaire lenses specified by catalog number and/or by descriptive reference shall be virgin acrylic plastic and shall equal or exceed IES-SPI-NEMA test for yellowing factor of not to exceed three (3) after 2000 hours exposure in a Fade-o-meter for the standard test conditions. The flat portions of all lenses shall be not less than .125 inches thick and shall weigh not less than eight (8) ounces per square foot.

3.3 Doors and other access means shall be smooth operating, free from light leakage under operating conditions and arranged to permit relamping without the use of tools. Arrange doors, frames, lenses, diffusers and other pieces to prevent accidental falling during relamping and when secured in operating position.

4. LED LUMINAIRES

4.1 All LED luminaires shall be tested in accordance with IESNA-LM-79. Provide LM-79 test results for the total luminous flux, electrical power, efficacy and chromaticity on luminaire cut sheets . All LED light sources' lumen maintenance shall be tested in accordance with IESNA-LM-80. Provide LM-80 test results on luminaire cut sheets.

4.2 All LED luminaires shall carry a minimum 5 year warranty on the entire luminaire and its components.

4.3 All LED luminaires shall be listed on the Qualified Products List (QPL) of the DesignLights Consortium.

4.4 LED luminaires shall be provided with proper driver and interconnecting wiring for proper operation with the supplied or existing lighting control device(s) or system. Coordination of luminaire components and lighting control components is the responsibility of the Contractor.

5. EMERGENCY BATTERY PACKS

5.1 Provide emergency battery packs for LED luminaires as required by the drawings. Battery packs for troffers and surface mounted LED luminaires shall be installed by the luminaire manufacturer within the luminaire housing unless otherwise noted on the drawings. Installation of all battery packs shall maintain accessibility from below regardless of ceiling type in which mounted. Battery packs shall be sealed, maintenance-free, high temperature nickel-cadmium type and provide the full fixture wattage and lumen output for a minimum of ninety (90) minutes after interruption of normal power to the luminaire. Battery packs shall be as manufactured by Bodine or approved equal.

- END OF SECTION -

260450 EQUIPMENT ELECTRICAL SERVICES

1. GENERAL

1.1 Provide and connect proper branch circuit(s) and final connection(s) to all equipment requiring electrical service(s). Equipment electrical service connections shall be as indicated on the drawings and/or as recommended by the equipment manufacturer. Branch circuit and final connection conduits shall be in accordance with SECTION 260110 "RACEWAYS AND FITTINGS".

1.2 Review architectural drawings and specifications and provide adequate electrical services for and make proper connections to all equipment furnished by the General Contractor requiring electrical service.

1.3 Carefully review plumbing and HVAC drawings and Division 23 of the specifications for mechanical equipment requiring electrical services. Provide adequate electrical services for and make proper connections to all such mechanical equipment requiring electrical service.

1.4 Electrical services and connections to equipment shall follow the equipment manufacturer's recommended method. Where the equipment furnished exceeds the circuit capacity or requires different characteristics than that shown on the drawings, this information shall be brought to the attention of the Professional prior to the branch circuit or connection rough-in.

1.5 The Division 26 Contractor shall immediately upon notice to proceed and after verification of service with the serving Utility Company notify in writing the General Contractor, the Division 23 Contractor(s) and all other affected Contractors the characteristics of the electrical service(s) of the facility(ies) including voltage and phase. A copy of this notification shall be submitted to the Professional with the project electrical shop drawings.

1.6 The equipment electrical service connection locations shown on the drawings are approximate and representative. Verify and coordinate actual electrical service rough-in locations, requirements, etc. with the Contractor providing the equipment and the associated manufacturer’s shop drawings.

2. MAINTENANCE DISCONNECTS

2.1 All power connections to equipment shall include a maintenance disconnect of the type indicated or if not specifically indicated as recommended by the equipment manufacturer in compliance with the NEC.

2.2 Maintenance disconnect switches for equipment shall be located adjacent to the associated equipment and readily accessible as defined by the NEC. Location of disconnect switches shall be fully coordinated with the equipment provider, the supplied equipment shop drawings and the adjacent building elements so as not to interfere with the correct placement and operation of the equipment. Maintenance disconnect switches shall be provided with lock-out provisions.

2.3 On multi-motor equipment connections (i.e. condensing units, roof-top HVAC units, etc.), the Division 26 Contractor shall verify with the Division 23 Contractor and obtain in writing the manufacturer's requirements for the equipment overcurrent devices. Provide HACR rated branch circuit breaker for each load in the serving panelboard of size as required by the manufacturer of the connected equipment. Where fuses or HACR breakers are permitted for overcurrent protection, utilize the serving HACR breaker for overcurrent protection and provide non-fused maintenance disconnect switch. Where fuses are required by the equipment manufacturer for overcurrent protection, provide fusible disconnect switch with fuse sizes as recommended by the manufacturer of the connected equipment. Obtain written approval from Division 23 Contractor of overcurrent device size and method before energizing equipment.

2.4 See Section 260410 “Wiring Devices” for additional requirements for Safety Switches.

3. HVAC EQUIPMENT ELECTRICAL SERVICES

3.1 Electrical service connections to ventilating fans shall include manual motor switch installed and connected where directed. Where fans are furnished with speed control devices, the Division 26 Contractor shall install the control device where directed and connect through it in addition to the manual motor switch. Where fans control or are controlled by other equipment such as timers, motorized louvers, firestats, EMCS control panels, etc., the Division 26 Contractor shall coordinate with the supplying Contractor and make connection to the fan through or with this device as required for proper operation.

3.2 Electrical service connections to HVAC equipment to include branch circuit wiring to the line side of line voltage control device such as magnetic starter, contactor, VFD, etc. and from load side of control device through motor terminals or equipment connection lugs. The control devices shall be furnished by the Division 23 Contractor and installed where directed by the Division 26 Contractor. Control devices which are integral pre-wired parts of equipment require connection to the line side of the control device only by the Division 26 Contractor unless otherwise indicated. All additional wiring including control wiring shall be furnished and installed by the Division 23 Contractor. Line voltage thermostats and other temperature control devices regardless of voltage shall be furnished, installed, wired and connected by the Division 23 Contractor.

4. OTHER EQUIPMENT ELECTRICAL SERVICES

4.1 The Division 26 Contractor shall provide proper branch circuit, disconnect device and final connection to all equipment requiring electrical service furnished under other Divisions of the specifications.

4.2 Set disconnect switch or other approved device if disconnect switch not shown adjacent to equipment and make final connection to the equipment as required in accordance with SECTION 260110 "RACEWAYS AND FITTINGS". Connection to include power wiring to the line side of the equipment controller or to the power connection location as applicable.

4.3 Division 26 Contractor shall obtain approved rough-in drawings for each item of equipment requiring connection and follow the manufacturer's recommendation as to the location and the method of connections.

4.4.1 Computer Equipment. The power connections and other electrical service or provision information shown on the electrical drawings are for estimating purposes only. The Division 26 Contractor shall refer to the approved Computer Equipment shop drawings or Architectural drawings, if shop drawings not available, for actual rough-in and electrical service information and shall provide the proper connections and provisions at the proper locations per these drawings. Electrical service characteristics (voltage, phase, ampere rating, etc.) shall be verify with the supplier of the computer equipment prior to rough-in. Computer equipment shall not be energized until electrical connections have been certified and approved by the proper authority.

4.4.2 System/Pre-Wired Furniture. Rough-in locations shown on the drawings are approximate and representative. Actual rough-in locations, mounting heights, etc. shall be fully coordinated with the Professional and the furniture supplier. Rough-in shall consist of three (3) gang partitioned box with three (3) gang raised cover mounted flush in wall or three (3) gang floor box with proper cover plate for furniture connection. Two compartments of the rough-in boxes shall be for telecommunications cabling connection provisions. See Section 260510 “Telecommunication Raceway System” for additional requirements. All power branch circuit connections to the furniture connection whips furnished with the furniture shall be by the Division 26 Contractor. Proper branch circuitry including proper number of phase, neutral and grounding conductors shall be provided as required by the supplied furniture. Branch circuit requirements shall be fully coordinated with the furniture supplier prior to any rough-in.

- END OF SECTION 260450 -

260510 TELECOMMUNICATION RACEWAY SYSTEM

1. GENERAL

1.1 Applicable requirements listed in Sections 260110 “Raceways and Fittings” and 260120 “Boxes and Fittings” shall apply. All telecommunication raceway installations shall comply with the applicable requirements of the ANSI/EIA/TIA standards.

1.2 Raceway system including conduits, boxes, plates and backboards as shown on the drawings by symbols and as specified herein.

1.3 Provide bushing on all conduits.

2. HORIZONTAL RACEWAY SYSTEM

2.1 Telecommunication system conduits and rough-in provisions shall not be less than six (6) inches from any source of alternating current unless separated by a grounded metallic partition.

2.2 Conduit routing shall follow most direct route possible to the designated termination point(s) within constraints of Section 260110 with no more than two (2) 90 degree bends between pull points and/or junction boxes. For conduit runs greater than 100 feet, provide junction box(es) sized per NEC such that no conduit segment exceeds 100 feet.

2.3 Conduit bend radius shall be minimum 6 times the internal diameter for conduits with internal diameters 2" or less and 10 times the internal diameter for conduits with internal diameters greater than 2".

2.4 Provide a nylon pull string with a minimum test rating of 200 lbs. in all empty conduits.

2.5 Work Area Outlets. Outlet boxes shall be 4" square X 2.5" deep with appropriate depth single gang raised cover unless noted otherwise on the drawings or required for the number of receptacles installed. Mount outlet boxes with center at same height as adjacent receptacles, as noted on the drawings or at sixteen (16) inches to centerline above the finished floor. Telecommunication outlets shall be mounted within 12" of adjacent power receptacle where shown on the drawings. Do not mount outlet boxes back-to-back.

2.6 Conduits serving work area outlets shall be 3/4" unless noted otherwise on the drawings and shall be routed to termination points as dictated by the drawing symbol(s) or notes. Conduit homeruns serving outlet boxes in rooms/spaces with accessible ceilings shall have in-line junction box mounted above the accessible ceiling to allow access to raceway for systems terminating within the space.

2.7 System/Pre-Wired Furniture rough-in provisions and connections shall include two 1 inch conduits for telecommunication cabling (voice and data) for each connection. Conduits shall be routed from proper compartments in furniture connection box (wall or floor) to telecommunication room, to above the accessible ceiling, to the J-hook system or to the cable tray system as shown or noted on the drawings or specified herein.

2.8 J-Hook System. A J-hook system shall be provided in all corridors, large open office areas or as shown or noted on the drawings for the routing and support of telecommunication cabling. The number of j-hooks provided for each system shall be as required for the number of cables installed plus 25% spare or as shown or noted on the drawings. No more than 50 cables shall be installed in a 2" diameter j-hook. See Section 260110 “Raceways and Fittings” for additional j-hook assembly requirements.

3. TELECOMMUNICATION ROOMS.

3.1 Provide telecommunication backboards as shown on the drawings or as a minimum one per telecommunication room. Backboards shall be 3/4" plywood minimum AC grade sized as shown on the drawings or 8' X 4' if size not indicated mounted with the long dimension vertical. Plywood backboards shall be void free and either fire-rated or treated on both sides with two coats of fire-resistant black enamel paint. Where required by local codes, cover plywood backboard w/sheet rock.

3.2 A grounding bus bar meeting the requirements of EIA/TIA 607 shall be provided in each telecommunication room or backboard location. The grounding bus bar shall be copper of minimum dimensions 20"X4"X1/4" with wall mounting bracket with insulators to isolate the ground bar. The ground bar shall have pre-drilled termination holes of proper size to terminate #12 through #4 AWG copper wire properly spaced over the entire length and width of the bar. The grounding bus bar shall be properly bonded to its associated grounding conductor using a properly sized mechanical lug.

3.3 A #6 grounding conductor in 1 inch conduit or size as shown on the drawings shall be provided from the electrical service entrance equipment ground bus to each telecommunication room ground bus bar. The grounding conductor may be installed “daisy-chained” from backboard to backboard or radially from service entrance equipment. A grounding type bushing shall be used at each end of the conduit and shall be properly bonded to the ground conductor at all wire exit points. Grounding conductor splices, if required, shall be made with irreversible compression type splices.

3.4 Where separation of the electrical service entrance and the telecommunication service entrance exceeds 20 feet, provide and connect a ground rod per Section 260250 “Grounding and Bonding Systems” within the telecommunication service entrance room. Bond the grounding bus bar in this room to the ground rod using #6 AWG copper conductor and to the electrical service entrance equipment ground bus.

3.5 Provide a minimum of two double duplex grounding receptacles or number as shown on the drawings on dedicated branch circuit(s) at each telecommunication system backboard. The telecommunication room receptacle branch circuits shall be routed through a branch circuit junction box mounted at the overhead structure or above the accessible ceiling where present within the telecommunication room to allow for future receptacle additions. Receptacle(s) shall be mounted at the specified height or as directed by the Professional or Owner and arranged so as not to be mounted behind conduits or cabling.

3.6 Service entrance, backbone and work area outlet conduits shall be stubbed into the telecommunication room in an accessible location using the minimum number of bends and offsets possible. Conduits entering from the floor slab or overhead structure shall be stubbed into the space 4 inches above the slab or below the bottom of the overhead structure.

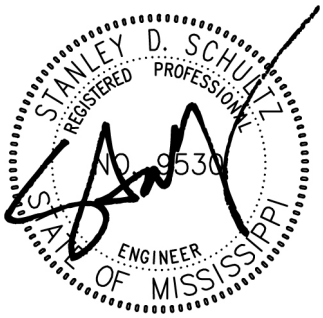
- END OF SECTION 260510 -

DIVISION 28 - SAFETY & SECURITY SYSTEMS

TABLE OF CONTENTS


| | | |
|---|---|---|
| 280010 | General Provisions | 280010 -1 / 5 |
| 280030 | Electrical Equipment/Material Submittals | 280030 -1 / 2 |
| 280110 | Fire Detection and Alarm System | 280110 -1 / 18 |


END OF DIVISION 28 TABLE OF CONTENTS




09/14/2021

SECTION 280010 SAFETY/SECURITY SYSTEMS

1. GOVERNING CLAUSE

1.1 For the sake of brevity, these specifications may omit phrases such as “Contractor shall provide”, “unless otherwise indicated or specified”, etc., but these phrases are nevertheless implied. Mention of materials and operations requires the Contractor to furnish, install and connect such materials and perform such operations to provide a complete and operating system to the satisfaction of the Professional.

2. GENERAL CONDITIONS

2.1 The General Conditions, Supplementary General Conditions, Information to Bidders, General Requirements, Addenda, Alternates and other pertinent documents issued by the Professional are a part of these specifications and shall be complied with in every respect.

2.2 Notwithstanding any reference in the specifications to any equipment, material or type of construction by name, make or catalog number, such reference shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Where the phrase “or approved equal” is used in the Division 28 Specification, substitute equipment, equivalent in all respects to that specified, of any qualified manufacturer is permitted with the written approval of the Professional. Approval will not be considered until after award of contract and only if submitted by the successful Contractor. Where a list of manufacturers and/or catalog numbers is provided and the phrase “or approved equal” is omitted, substitute equipment, equivalent in all respects to that specified, from one of the listed manufacturers is permitted with the written approval of the Professional.

3. TEST AND OBSERVATIONS

3.1 The complete project shall be, during and/or after construction, subject to the tests and observations as herein described and as noted on the drawings. Deficiencies found as a result of these tests and observations shall be corrected by the Contractor within a reasonable period and at no expense to the Owner.

3.2 The complete project shall be subject to observations and tests conducted by the Professional or for him in his presence. Upon notice, the Contractor shall furnish not to exceed two men, one to include the job foreman, and tools to assist and be directed by the Professional for a reasonable amount of time to make such tests and observations as are requested by the Professional.

3.3 The complete project shall be subject to observations and tests conducted by any Federal, State and/or local authority having jurisdiction. The Contractor shall make all corrections of any deficiencies required by the authority having jurisdiction to allow building occupancy.

3.4 The complete project shall be subject to observations and tests conducted by the Owner’s Insurance carrier. After inspection by this agency, Contractor shall make corrections of any deficiencies found adversely affecting the insurance to be carried by the Owner. Acceptance of this report or subsequent reports lie with the Professional or Owner.

4. RECORD DOCUMENTS

4.1 The contractor shall provide to the Professional with the Close-Out Documents the following:

a. Two (2) sets of blue line “as-built” prints of same scale as original drawings legibly marked in red showing all variations in the installed work from the requirements of the original contract drawings. The “as-built” drawings shall include all addenda, approved and installed change orders, field condition changes and other departures from the original plans and specifications.

b. Three (3) sets of shop drawings and other data required by the specifications reflecting the manufacturer's shop fabrication of the materials actually installed. The Division 28 shop drawings shall be separately post bound, indexed and tabbed by specification section. Faxed or copies of faxed material shall NOT be used in Close-Out Documents.

c. Operation and maintenance manuals and manufacturer’s instructions for all equipment and systems installed.

d. Copy of all reports of system, equipment or material test as required by this specification.

5. GUARANTEE

5.1 The Contractor shall guarantee to the Owner all work performed under this contract to be free from defects in workmanship and materials for a period of one year from the date of final acceptance by the Professional and the Owner except as hereinafter noted.

5.2 The Contractor shall correct, repair and/or replace upon notice from the Owner or his authorized representative within a reasonable period of time any defects in the work performed under this contract arising during the warranty period. This repair work shall be provided at no additional cost to the Owner.

6. ELECTRICAL SYSTEMS SCHEDULE

6.1 Provide and connect all equipment and materials for complete and operative systems as follows:

Fire Detection & Alarm System.
Miscellaneous Systems as shown on the drawings or stated herein.

7. GENERAL

7.1 The Systems specified herein require specialized skill and experience in their installation and shall comply with the requirements of this Section of the Specifications.

7.2. Each System shall be installed and connected in strict compliance with applicable codes and standards including NFPA, IBC, SBC, NEC, UL and ANSI.

7.3 System(s) components and device locations shown on the drawings are approximate and representative and for estimating purposes only. Actual locations shall be coordinated with the architectural finishes encountered, other equipment and building structural elements. Component and device locations shall be properly located to provide maximum System performance in the room/space shown. All required mounting hardware and accessories shall be provided as required by the area and finishes encountered.

7.4 Prior to component and/or device rough-in, the Company suppling the System(s) shall review the System(s) component and device locations, layout, etc. and make recommendations and any revisions necessary to facilitate maximum System performance. Proposed changes shall be shown and indicated on the System(s) one-line diagram(s).

8. EQUIPMENT

8.1 System components shall be purchased from and supplied by a factory authorized company who maintains a complete inventory of spare parts and who has an active and experienced service organization capable of providing repair service within 24 hours of notification.

8.2 Each component/device of the System(s) shall be UL listed. The installation of each component/device shall comply with the UL listing, applicable codes and standards, the manufacturer's recommendations and this specification.

8.3 Component and device storage on the site shall include special precautions against temperature and humidity variations which exceed the manufacturer's recommendations. Any component or device which has been damaged due to storage conditions shall be repaired or replaced as directed by the Professional at no additional cost to the Owner.

9. INSTALLATION

9.1 System installation shall be by factory-trained, well experienced technicians employed by the Company supplying the System components and devices. These technicians shall perform the following System installation procedures as a minimum:

a. Perform all wiring connections at each component and device and all splices and/or terminations made at junction or pull boxes.

b. Perform testing of all wiring after installation and prior to connection to components to verify System is free of grounded or open circuits.

c. Perform complete System operational test. This test shall be completed prior to any third party testing required by this specification.

d. Perform operation and maintenance training of installed System to Owner's personnel.

e. Provide System certification letter to the Professional prior to Substantial Completion stating that the System has been installed and is operating in accordance with the applicable codes and standards, this specification and the manufacturer's recommendations.

9.2 System wiring shall be installed in conduit unless otherwise shown or noted on the drawings or within this specification. Conduit and wiring though not shown on drawings shall be provided by the Contractor to accomplish the intent of the System as shown on the drawings by symbols and this specification.

9.3 System design is intended to show types of devices, appliances, etc. and their associated functions and operations required for each space. Quantities, spacing and location of these devices, appliances, etc. to perform the intended function shall be the installing Contractor's responsibility and shall comply with applicable codes and standards and this specification.

9.4 System wiring and equipment installation shall be in accordance with good engineering practices as established by the EIA/TIA and the NEC and with the manufacturer's recommendations. All wiring terminations and splices shall be made using proper compression type connectors or terminal strips. Wire nut type connectors of any kind shall not be used on System wiring.

9.5 The Company suppling the System(s) shall submit to the Professional prior to Substantial Completion a letter on the Company letterhead for each System installed under the Special Systems provisions signed by their supervising technician(s) for this Project(s) stating that all component/device installations and all wiring connections, terminations and testing were performed by factory-trained technicians in the regular employment of the suppling Company.

10. TESTING AND DEMONSTRATION

10.1 A representative of the Company supplying the System who is completely familiar with the operation, functions and maintenance of the installed System shall provide operation and maintenance training for the Owner on the System and the associated programming software. The representative shall inform the Owner of all the System's available operations and functions, and after consultation with the Owner, shall provide program adjustments to the System in order for it to perform per the Owner's request. Contractor shall allow one additional site visit during the one year warranty period for re-programming and/or re-configuring of the System(s) at the Owner's request at no additional cost to the Owner.

10.2 This operation and maintenance training shall be fully coordinated and scheduled with the Owner and the Professional and shall be held at the convenience of the Owner. Contractor shall provide signed statement from the Owner's representative with Close-Out Documents on each System installed stating that the System was demonstrated to the Owner's satisfaction.

10.3 The required operation and maintenance training session(s) on each System demonstrated shall be video taped by the Contractor and the tape submitted to the Professional with the Close Out Documents. The recording media shall be compatible for playback on a standard VHS format video cassette recorder (VCR). Any adapters or other interface devices required for playback shall be provided.

10.4 Prior to the Project's Substantial Completion, the complete System(s) shall be tested and physically inspected by the installing technician(s) for proper operation and installation. Any deficiencies shall be corrected. This testing shall be performed prior to any third party testing required by other Sections of this Specification.

- END OF SECTION 280010 -

SECTION 280030 EQUIPMENT/MATERIAL SUBMITTALS

1. GENERAL

1.1 Equipment is specified by manufacturer's name and catalog number and is intended to establish the minimum standards of quality acceptable.

1.2 Substitute equipment, equivalent in all respects to that specified, is permitted with the written approval of the Professional. Approval will not be considered until after award of contract and only if submitted by the successful Contractor.

1.3. The manufacturer's name and/or catalog number first mentioned in this specification is considered to be the specified equipment. The "or equal" manufacturers mentioned or other manufacturers proposed by the Contractor shall be considered as substituted equipment.

1.4 Substituted equipment shall meet the dimensional and functional requirements of the building as represented by the plans and specifications. All revisions to the contract precipitated by the use of substituted equipment shall be incorporated by the Contractor, after approval in writing by the Professional, and at no additional cost to the Owner.

1.5 The Professional's approval of the shop drawings is only for general conformance with the design concept of the Project and the information given in the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site; information that pertains solely to the fabrication process or to the means and methods of construction; coordination of work of all trades; and performing all work in a safe and satisfactory manner. Approval of the shop drawings does not modify the Contractor's duty to comply with the Contract Documents. Any equipment or work found in the judgement of the Professional to be defective or otherwise unsuitable shall be repaired or replaced by the Contractor at no additional cost to the Owner.

1.6 If requested in writing by the Professional, the Contractor shall submit a scale drawing (scale as directed by the Professional) of any electrical equipment area, conduit layout or the like which in the opinion of the Professional may present difficulty regarding space allocation or clearances.

2. SUBMITTALS

2.1 After the project notice to proceed has been issued and with promptness to assure reasonable time for review with no delay to the project, the Contractor shall submit to the Professional a minimum of six (6) copies of shop drawings for all equipment and material for the electrical systems for approval whether or not substituted equipment or materials.

2.2 Shop drawings shall be post-bound, indexed and tabbed or filed if electronically submitted per the appropriate specification sections. All material/equipment shop drawing cut sheets shall be properly located under the appropriate specification section. All shop drawings shall be originals (no faxed copies) and shall be readable without being removed from the bindings. All information listed on the shop drawings shall be typed. Handwritten information will not be accepted.

2.3 Space shall be provided on the title or index page of each section of the shop drawings for the Professional's review stamp and comments. This space shall be clearly labeled as to its use and shall have a minimum size of 7" wide X 5" high.

2.4 All submitted equipment/material and associated options, accessories, special features, etc. shall be clearly marked and indicated on all copies of the shop drawings. Provide appropriate shop drawings on all required accessory equipment.

2.5 All shop drawings for all systems, equipment and materials including any required one-line drawings, diagrams, etc. shall be submitted together. Partial submittals will not be reviewed without prior consent. Special systems provided by specialized vendors or distributors may be submitted in a separate binder.

2.6 Provide complete shop drawings with all pertinent information for each system specified and all required components.

2.7 Special Systems submittals shall include a complete System one-line diagram prepared by the Company suppling the System components and devices.

a. The one-line diagram shall show each component and device, all interconnecting wiring and conduit, terminal strips with numbering, pull and junction boxes, device zoning or device addresses where applicable and any other information which is deemed necessary by the Professional. The type, size and number of wires shall be shown for each interconnection circuit. The number and size of all conduits and boxes shall be identified on the drawing. The conduit routing and wiring shown on the one-line drawings shall accurately depict the actual installation of the System in the field.

b. The one-line diagram drawings shall be produced using a commercially available CAD software program capable of producing electronic drawing files compatible with AutoCad software. Drawing symbols and lettering shall be neat and legible and printing line weights used shall clearly distinguish System components/devices from background floor or site plan elements. All lettering shall be upper case. When background drawing (floor plan, site plan, etc.) requires paper size to exceed 11"X17", the scale of the System one-line drawing shall be one-half the scale of the Contract Drawings and printed on the smallest adequate standard size paper.

2.8 Three (3) copies of complete operational and maintenance manuals for each installed System shall be provided to the Professional with the Close-Out Documents. These manuals shall be post-bound and indexed and shall include catalog information, operating procedures in detail, wiring diagrams of all components, complete system one-line diagrams, and the address and phone number of the service department of the suppling Company.

- END OF SECTION 280030 -

SECTION 28 0110
FIRE DETECTION AND ALARM SYSTEM

A. GENERAL

1. CODES and STANDARDS

1.1 Shall be installed in conduit. Conduit and wiring though not shown on drawings shall be provided by the contractor to accomplish the intent of the system as shown on the drawings by symbols and this specification. The Contractor shall include only the labor, conduit, boxes, 3rd Party Testing and coordination with vendor of the sole source procurement for devices and equipment to install a complete Fire Alarm System as shown and specified. The devices, cables, final terminations, programming and documentation shall be provided by others.

1.2 The Fire Detection and Alarm System(s) and its/their installation shall comply with the latest revisions all applicable codes and standards including NFPA, IBC, SBC, NEC and the Americans with Disabilities Act (ADA).

1.3 Each component of the system shall be listed under the appropriate category(ies) by Underwriters' Laboratories, Inc. (UL). The complete system installation shall conform to the applicable sections of NFPA-72, NEC 760, Local Code requirements and to the individual component's UL listings. All components and control panel(s) shall be by the same manufacturer.

1.4 The requirements of Section 280010 "SAFETY/SECURITY SYSTEMS" and other applicable sections of this Specification shall apply and shall be fully complied with.

1.5 System installation including all wiring connections, splices and terminations at all devices, panels, components, junction points, etc. and testing of installed wiring shall be performed by factory trained and certified personnel of the System manufacturer and/or NICET Level 2 certified personnel.

2. SCOPE of WORK

2.1 Extend and connect the existing Fire Detection and Alarm System(s), hereinafter referred to as the "System" in this section of the specifications, consisting of non-coded, analog addressable, microprocessor based control panel(s), remote annunciator(s), addressable alarm initiating devices, visual and audio/visual alarm devices and a fully supervised wiring system for a complete and operational Fire Detection and Alarm System(s) conforming to NFPA 72, the drawings and this specification. The Fire Alarm devices, cables, final terminations, programming and associated documentation shall be provided by Others. The Contractor on this project shall provide the rough-in, device installation, pulling cables, testing, and shall be responsible for a fully functional, complete Fire Alarm System expansion in accordance with these plans and specifications.

3. CONTRACTOR QUALIFICATIONS

3.1 The Fire Detection and Alarm System Contractor, hereinafter referred to as the "Contractor" in this section of the specifications, shall be an experienced company with local representation regularly engaged in the design and installation of fire detection and alarm systems of similar size and complexity as required for this project and have the following minimum qualifications:

a. Personnel factory trained and certified in the design of the System to be provided.
b. Personnel factory trained and certified to install and connect the System components to be provided.
c. Personnel knowledgeable in local, state, province and national codes and regulations.
d. Possess required licenses/permits to perform required installations in the jurisdiction in which the project is located.
e. Operating as a business under the same name currently being used for a minimum of five (5) years.

3.2 Provide with the System(s) shop drawings a copy of all certifications and registrations of the Contractor's personnel that will be involved with the design and/or installation of the System(s).

3.3 At the request of the Professional, the System Contractor shall provide in writing references of a minimum of three successfully completed projects of similar size and complexity as this project which have been completed by this Contractor in the three year period preceding this project's bid date. References shall include project name, location, Owner's contact person and telephone number.

4. SYSTEM MANUFACTURERS

4.1 The fire detection and alarm system shall have the operational functions as specified herein and shall be equal to the specified equipment in all respects. The following listed manufacturers are approved for consideration for this project. Other System manufacturers must obtain prior written approval from the Professional for substitution and submission for this project.

Approved System Manufacturers:

a. JCI (Johnson Controls/ Simplex/Grinnell)

4.2 The supplying vendor of the System shall be located within 100 miles of the campus and shall have a maintenance and repair staff and adequate local spare parts inventory.

5. System(s) components and device locations shown on the drawings are approximate and representative and are intended to establish the type of protection, monitoring or alarm notification required for the associated room, space and/or area. The final and actual number of devices, their coverage and/or output rating and their locations shall be determined by the System manufacturer to provide full coverage of the intended function of the area in accordance with NFPA 72. Locations of components and devices shall be fully coordinated with the architectural finishes encountered, other equipment and building structural elements. Additional devices required for proper operation of the System shall be shown on the submitted System one-line drawings.

B. BASIC SYSTEM OPERATION

1. ALARM INITIATION

1.1 Actuation of any initiation device or interface device shall cause the following actions:

a. Activate general alarms (audible and visual).
b. Display individual initiating device address and description at control panel(s) and remote annunciator(s).
c. Provide activation signals and interfaces to other systems as herein specified.
d. Transmit signal over telephone lines to central fire reporting station via communicator.
e. Record the event in the historical log.

1.2 The System shall monitor the connected devices and associated circuitry and shall initiate a supervisory or trouble notification as required by NFPA 72 for the wiring classification specified. A supervisory or trouble signal shall initiate the associated audible and visual alarms at the associated FACP and remote annunciator(s) and shall record the event in the historical log.

C. SYSTEM COMPONENTS

1. CONTROL PANEL(S)

1.1 The Fire Alarm System Control Panel(s) (FACP) is existing and shall be configured and contain all hardware, software and power to supervise, monitor and control all the devices connected plus an additional 25% spare capacity. The control panel(s) shall have a minimum expandable point capacity as the specified equipment or as required for the connected devices including spare capacities which ever is greater.

1.2 FACP(s) shall contain power supply(ies) of size and number as required for proper system operation for the number of devices and components connected plus 25% spare capacity. Activation or operation of any device(s) shall not interfere with the normal operation, subsequent activation and/or alarm operation of any other connected component due to system design, wiring or power limitations.

1.3 FACP shall audibly and visually annunciate all alarm, supervisory and trouble conditions on the System. Visual annunciation shall be by liquid crystal display (LCD) with minimum 80 characters.

1.4 All wiring shall be installed in a neat and workmanlike manner with conductors routed parallel or perpendicular to sides and/or back of the enclosure and properly tie wrapped and bundled. All wiring shall be properly labeled.

1.5 FACP shall be provided with alarm silence, trouble/supervisory silence and alarm reset selector switches. Visual alarm indications shall not be canceled by the operation of an audible alarm silencing means. Cancellation of visual alarm indications shall be by Reset of the System only.

1.6 Operating software shall include the following features as a minimum: smoke sensor alarm verification, “walk test”, event historical log with date and time indications, operator “password” access levels (minimum four) and addressable device custom labeling.

1.7 System(s) operational programming shall be provided by certified factory-trained technician(s) and shall be customized for the facility(ies) in which the system(s) is/are installed per this specifications and applicable codes. Addressable device display labels shall be programmed for plain language readout per the direction of the Owner/Professional. Device display labels shall include associated room numbers in which the device is located and the room numbers shall be taken from the final room number designations issued by the Owner/Professional.

1.8 The System(s) alarm notification shall be VOICE ALARM consisting of a three cycle alarm tone followed by a pre-recorded voice message in accordance with applicable codes and standards. The pre-recorded voice message shall be repeated until the System is silenced or reset. The Systems shall provide microphone provisions at the FACP for the broadcast of live instructions via the System audible alarm devices. Live announcements shall override the pre-recorded alarm message. The System shall have the proper power capacity to operate all connected voice alarm devices simultaneously.

2. SYSTEM POWER

2.1 Provide and connect a dedicated power branch circuit to each FACP or other System component(s) requiring power. The serving power branch circuit breaker(s) shall be clearly labeled using red lettering “Fire Alarm Circuit” and the associated circuit breaker(s) shall have a red identifying mark. The serving power branch circuit breaker(s) shall be equipped with a listed circuit breaker lock to prevent tampering. The associated serving power branch circuit panelboard designation, circuit number and panelboard room location shall be identified on the inside of the enclosure door of each FACP or other System component. The normal power source(s) to the system(s) shall be supervised so that any power failure must be audibly and visibly indicated at the control panel and the remote annunciator(s). A green "power on" LED shall be displayed continuously while incoming power is present.

2.2 Standby battery(ies) shall be sealed, maintenance free type complete with metered charger(s) and shall be provided and connected as required to operate the complete

System plus required spare capacities for 24 hours with 5 minutes of alarm operation at the end of this period. Standby batteries shall be located in the same cabinet as the associated FACP or immediately adjacent to the FACP cabinet in a separate cabinet.

2.3 The System(s) shall automatically transfer to stand-by battery operation upon failure of the normal power source. All battery charging and recharging operations shall be automatic. Battery charger(s) shall be rated for recovery of batteries from full discharge to full charge in 24 hours or less.

2.4 The System batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visibly indicated at the control unit and the annunciator. If a “LOW BATTERY” condition is left unattended a second stage “DEPLETED BATTERY” trouble condition shall be audibly and visibly reported at the control unit indicating the batteries are below the listed system operating voltage. Systems that completely shut down and fail to indicate a “DEPLETED BATTERY” condition shall be unacceptable.

2.5 Provide with the shop drawings complete battery calculations for both the alarm and supervisory power requirements for the System(s).

3. REMOTE ANNUNCIATOR(S)

3.1 Shall be provided and connected where shown on the drawings or at the facility’s main entrance where directed by the Professional if location not shown.

3.2 Shall contain minimum 80 character LCD display. Displayed information shall include point address, point status (alarm, trouble, etc.), alarm type (smoke detector, manual station, etc.), number of system alarms, supervisory conditions and troubles, and a custom device location label. Alarm, supervisory and trouble conditions shall be indicated by dedicated LEDs and an audible signal. “Alarm Silence” and “System Reset” switches shall be provided.

3.3 All switches and control functions on the annunciator shall be controlled by an “enable” key switch with the key removable in the “disable” position only.

4. ALARM DEVICES

4.1 Audible/visual and visual alarm devices shall be provided and connected throughout the facility(ies) located as shown on the drawings and as required to produce audible and visual alarms in accordance with NFPA 72, ADA and the Contract Documents.

4.2 Visual alarm devices provided in rooms (with the exception of corridors/hallways) whose effective rectangular (length X width) dimensions (measured from the longest points) exceed 20'L X 20'W shall have a light output of 110 candela. Visual alarm devices in corridors and other spaces shall have a light output of 15/75 candela unless noted otherwise on the drawings.

4.3 Unless shown or noted otherwise, visual alarm devices shall be semi-flush, vertically wall mounted devices with red housing and white “FIRE” lettering on three sides utilizing a xenon flash tube with polycarbonate lens.

4.4 Unless shown or noted otherwise, audible/visual alarm devices shall be semi-flush, horizontally wall mounted devices with red housing and white “FIRE” lettering on three sides utilizing a xenon flash tube with polycarbonate lens.

4.5 Alarm devices shall be mounted center line up 80" above the finished floor unless otherwise shown or noted on the drawings or herein specified.

4.6 When the FACP is provided with Voice Alarm, audible alarm devices shall be of the proper type and with proper output rating to produce alarm tones and voice alarm messages unless specifically shown or noted otherwise on the drawings or herein specified.

4.7 When multiple alarm strobes and/or their reflections can be seen from one location, the strobe flash rates shall be synchronized.

5. PULL STATIONS

5.1 Shall be semi-flush mounted, double action, non-coded addressable manual stations. Housings and levers shall be high-impact Lexan or cast metal with a red housing finish color. Reset of station shall be by key or wrench. Stations which require the replacement of any portion of the device after activation are not permitted.

5.2 Shall be provided and connected at all exterior exit doors and in each corridor where required to limit spacing between devices to 200 feet

5.3 Shall be mounted centerline up 48" above the finished floor unless otherwise shown or noted on the drawings or herein specified. Where shown at exit door ways, pull stations shall be mounted within 5 feet of the edge of the door.

5.4 Each pull station shall be provided with a clear Lexan protective shield with integral sounder.

6. SMOKE SENSORS

6.1 Shall be analog photoelectric type, addressable and shall be provided as shown or noted on the drawings and/or as specified herein.

6.2 Detectors shall have 30-mesh insect screens, LED power indicator and functional test switch (magnetically operated). Detectors requiring control interface with external systems (i.e. air handling units, etc.) shall be provided with all required NC & NO contacts or zone addressable control module(s) which shall be used for interface with other Sections of these Specifications. The operation of each contact shall be programmable at the control panel.

6.3 Smoke sensors shall be ceiling mounted unless otherwise shown or noted on the drawings or herein specified. Ceiling mounted sensors shall not be less than 4 inches from a sidewall to the near edge. Wall mounted sensors shall be mounted at least 4 inches but not more than 12 inches below the ceiling.

6.4 Smoke sensor locations shown on the drawings are approximate and representative. Sensors shall be located as required for proper operation, as recommended by the manufacturer, in compliance with NFPA 72 and to provide optimum coverage of the space installed. Sensors shall not be located in direct air flow or within 36 inches of an air supply diffuser.

6.5 Smoke sensors shall not be installed until after construction clean up or shall be provided with the proper covers to prevent the migration of debris into the sensor.

6.6 Where shown or noted on the drawings or as required by the governing codes, smoke sensors shall be provided with integral audible alarms.

7. THERMAL SENSORS

7.1 Shall be analog, fixed temperature and rate-of-rise sensing, 135 degree unless noted otherwise, addressable and shall be provided as shown or noted on the drawings and/or as specified herein.

7.2 Sensors requiring control interface with external systems shall be provided with all required NC & NO contacts or addressable control module(s) which shall be used for interface with other Sections of these Specifications. The operation of each contact shall be programmable at the control panel.

7.3 Thermal sensors shall be ceiling mounted unless otherwise shown or noted on the drawings or herein specified. Ceiling mounted sensors shall not be less than 4 inches from a sidewall to the near edge. Wall mounted sensors shall be mounted at least 4 inches but not more than 12 inches below the ceiling.

7.4 Thermal sensor locations shown on the drawings are approximate and representative. Sensors shall be located as required for proper operation, as recommended by the manufacturer, in compliance with NFPA 72 and to provide optimum coverage of the space installed. Sensors shall not be located in direct air flow or within 36 inches of an air supply diffuser.

8. DUCT MOUNTED SMOKE SENSORS

8.1 Shall be analog, addressable photoelectric type smoke sensors with duct housings, sampling tubes, etc. and shall be provided and properly installed at air handling duct systems as specified herein.

8.2 Each duct detector shall be provided with a remote alarm and test station installed as directed by the Professional or as shown on the drawings.

9. COMBINATION SMOKE/CARBON MONOXIDE SENSORS

9.1 Shall be analog photoelectric type, addressable with integral carbon monoxide sensor and audible alarm and shall be provided as shown or noted on the drawings and/or as specified herein.

9.2 Sensors shall be ceiling mounted unless otherwise shown or noted on the drawings or herein specified. Ceiling mounted sensors shall not be less than 4 inches from a sidewall to the near edge. Wall mounted sensors shall be mounted at least 4 inches but not more than 12 inches below the ceiling.

9.3 Sensor locations shown on the drawings are approximate and representative. Sensors shall be located as required for proper operation, as recommended by the manufacturer, in compliance with NFPA 72 and to provide optimum coverage of the space installed. Sensors shall not be located in direct air flow or within 36 inches of an air supply diffuser.

9.4 Sensors shall not be installed until after construction clean up or shall be provided with the proper covers to prevent the migration of debris into the sensor.

10. CONTROL/MONITOR MODULES

10.1 Control/monitor modules shall be provided as shown and/or noted on the drawings and/or as required for system interfaces as specified herein.

10.2 Control/monitor modules shall be individually addressable and shall be capable of configuration for latching or momentary contact operation. The operation and function of each contact shall be separately programmable at the FACP.

10.3 Control/monitor modules shall have the minimum number of interface contacts or contact monitoring circuits to perform the function or operation specified or required. Where the number of interfaces exceeds the available number of contacts in a single module, multiple modules shall be provided as required.

D. SYSTEM INTERFACES

1. AIR HANDLING UNITS.

1.1 Duct mounted smoke sensors as specified herein and required accessories shall be provided, connected and properly installed at air handling duct systems in the main supply duct on the downstream side of filters and/or in the return duct prior to exhausting from the building or the introduction of outside air of air handling units as designated on the drawings.

1.2 Division 28 Contractor shall review Mechanical drawings and specifications for air handling unit locations, areas served, duct work routing, etc.

1.3 The sensors shall be provided with all required NC & NO contacts or zone addressable control module which shall be used by the Mechanical Contractor for air handling unit shut down. The operation of each contact shall be programmable within the System operational program. Programmable sensor base(s) and/or proper addressable control module(s) shall be provided as required. Interface wiring and connection requirements for air handling unit shut down shall be the responsibility of the Mechanical Contractor.

2. FIRE PROTECTION SYSTEM(S)

2.1 Proper addressable alarm initiating devices with required associated equipment shall be provided and connections shall be made to monitor each required component of the fire protection (sprinkler) system including wiring supervision. Monitoring devices and associated connections shall be provided for all flow indicating switches, post indicator valves (PIVs), wall indicator valves (WIVs) and OS&Y valves.

2.2 Operation of flow indicating switch(es) shall cause a general alarm and closing of PIVs/WIVs or OS&Y valve shall initiate a supervisory signal. Each flow switch and supervisory indication shall have a separate address.

2.3 Proper control/monitoring modules shall be provided and interfaced with each fire pump controller to monitor the controller operating conditions as required by NFPA 20. Fully coordinate requirements and connections with the Fire Protection System contractor.

3. FIRE EXTINGUISHING SYSTEM(S)

3.1 The necessary addressable control/monitoring devices shall be provided and properly connected to supervise and accept general alarm initiation signal(s) produced by the following:

a. Range/exhaust hood fire extinguishing system.
b. Gaseous fire extinguishing system.
c. Electronic computer/data processing equipment alarm systems.

3.2 Addressable control modules shall be provided and connected and properly interfaced with the associated system(s) as required to perform shunt-trip of the power branch circuit(s) serving the power connection(s) and/or device(s) required to be de-energized in an alarm condition by the governing codes.

4. ELEVATORS

4.1 Smoke sensors as herein specified shall be installed in all elevator lobbies, machine room(s) and at the top of hoistway(s).

4.2 For each group of elevators, the System shall interface with the elevator controller(s) via addressable control module(s) to provide signals as follows: (1) to indicate activation of the smoke detector at the “designated” recall level elevator lobby, (2) to indicate activation of any smoke sensor at any level elevator lobby other than the “designated”

recall level, and (3) to indicate activation of any smoke sensor in the elevator hoistways or machine room(s).

4.3 Thermal sensors as herein specified shall be installed in elevator machine room(s) and at the top of elevator hoistway(s). The thermal sensor(s) shall be installed within 24" of the associated fire protection system sprinkler head(s) where provided.

4.4 Thermal sensors shall interface with electrical power distribution system via addressable control module(s) to automatically control the shunt trip of associated elevator power circuit breaker(s) prior to the application of water in the hoistway(s) and/or machine room(s). The Division 16 Contractor shall coordinate sensor activation temperature with Fire Protection Contractor and shall activate shunt trip of required power sources prior to the application of water in the elevator spaces.

5. EXIT DOOR RELEASE

5.1 Provide addressable control device(s) and connection(s) including wiring supervision to all devices and/or systems intended to effect the locking/unlocking of emergency exit doors. Upon any alarm activation of the System, provide proper signal and interface action to each device and/or system to unlock all emergency exit doors.

E. INSTALLATION

1. System wiring shall be installed in conduit. Conduit and wiring though not shown on drawings shall be provided by the Contractor to accomplish the intent of the System as shown on the drawings by symbols, as specified herein and as required to comply with governing codes and standards.

2. System wiring and equipment installation shall be in accordance with good engineering practices as established by the EIA/TIA and the NEC and with the manufacturer’s recommendations. All wiring terminations, splices and junctions shall be made using proper compression type connectors or terminal strips. Wire nut type connectors of any kind shall not be used on System wiring.

3. System wiring shall the following class and style designations as defined by NFPA 72 and shall initiate the proper signal per NFPA 72 at the FACP(s) and remote annunciators: Initiating Device Circuits (IDC) - Class B, Style A; Signaling Line Circuits (SLC) - Class B, Style 0.5; Notification Appliance Circuits (NAC) - Class B, Style W.

4. The System and associated components shall be protected against transient over voltages in accordance with the applicable requirements of ANSI/IEEE C62.41 by proper devices installed on incoming power circuits and all circuits routed outdoors or terminated on devices located outdoors.

F. TESTING & DEMONSTRATION

1. See Section 280010 “Safety/Security Systems” for additional testing and demonstration requirements.

2. The installed and/or modified Fire Detection and Alarm System(s) and all associated devices and connections shall be tested in accord with the manufacturer’s recommendations, applicable codes and standards, and testing guidelines as herein specified. Testing shall be performed by an independent, third-party Company qualified to test the system involved. Testing Company qualifications shall be submitted to the Professional for approval prior to the beginning of testing.

3. A full test report as outlined in this specification shall be submitted to the Professional in writing prior to substantial completion. Where System(s) operations involve other Divisions of the Specifications, the affected Professional shall verify by signed written statement that the operation performed by the System(s) specified herein was correct and complete. Retesting as necessary to achieve a complete report(s) with no deficiencies shall be required. The Professional will perform random component testing at Substantial Completion at his discretion. Should any part of the System(s) not perform correctly, a complete re-test of the entire System(s) can be required with no additional or increase in Cost to the Owner. If more than one re-check of the System(s) by the Professional is required to verify proper System(s) operation, the Contractor will be billed for the time and expense of the Professional.

4. A System Record of Completion as required and published in NFPA 72 shall be completed by the installing Contractor and submitted to the Owner and a copy of the report shall be included with the Close-Out Documents.

G. EQUIPMENT

1. A service contract offering continued factory authorized service after the contract provided one (1) year parts and service warranty of the installed system shall offered in writing and be made available if requested by the Owner.

2. Rough-in requirements (conduit, boxes, etc.) for all components, devices, etc. shall be as recommended by the System manufacturer and per applicable codes for the situation encountered.

3. The component/device quantities, locations, etc. shown on the drawings and/or specified herein are intended to indicate the type of devices and associated sensing requirements in each room/space. The actual quantity, spacing, locations, etc. of devices and components shall be the responsibility of the System provider per his System’s design requirements and limitations, applicable codes and standards, and the contract documents.

4. The Fire Detection and Alarm System(s) shall be as manufactured by Simplex/Grinnell 4010 Series with compatible peripheral devices per this specification and with accessory components as required for proper system operation per this specification and associated Codes and Standards. Quantities shall be as shown on the drawings, as defined in this specification and/or as required for proper System(s) operation per the drawings and this specification. All cables and conductors shall be as recommended by the System manufacturer. All back boxes, junction boxes, etc. shall be as recommended by the System manufacturer for the installation situation encountered.

**FIRE ALARM SYSTEM INSPECTION/TEST REPORT ON FOLLOWING PAGES**

- END OF SECTION 280110 -

# FIRE ALARM SYSTEM INSPECTION/TEST REPORT

I. Testing Organization

Company Name:_____ Test Date:_____

Representative:_____ Title:_____

Telephone Number:_____ Fax Number:_____

| | | YES | NO |
|---|---|---|---|
| 1 | Prior to starting this test, has the Testing Organization been approved by the Professional? | | |

II. Project Information

Project Name:_____ W/O Job No.:_____

Project Address:_____

III. System Information

Fire Alarm System Manufacturer:_____

Model No.:_____ Serial No.:_____

Installed Software and Revision:_____

IV. Test Requirements

The system shall be tested by a representative of the testing organization and all test results shall be reported as witnessed by him. A negative answer to any of the following questions shall be explained in sufficient detail on a separate typed document.

A. General.

| | | YES | NO |
|---|---|---|---|
| 1 | Installed Fire Alarm and Detection System(s) and all associated equipment, devices, etc. are as submitted in the approved Shop Drawings? | | |
| 2 | All devices, equipment, etc. have been installed correctly per the manufacturer's recommendations and the Contract Documents? | | |
| 3 | All devices, equipment, etc. have been installed at the approximate locations and mounting heights as shown in the Contract Documents? | | |
| 4 | After silencing of audible alarm, all visual alarm devices continued to operate until the System was reset? | | |
| 5 | All wiring has been tested for shorts, grounds and open circuits? | | |
| 6 | All alarm and initiating devices have been tested for proper operation and have been made to properly operate at least twice? Properly complete attached initiating test for each initiating and supervision device. | | |
| 7 | Alarm and trouble indication is properly annunciated at control panel(s) and remote annunciator(s) for all connected initiating devices by address, description and location? | | |
| 8 | Initiating device descriptions and locations as indicated at control panel(s) and remote annunciators(s) adequately describe and located the devices within the building? | | |
| 9 | Installed battery back-up properly provides power to maintain proper system operation when the normal power source is de-energized? | | |
| 10 | The installed automatic dialer properly operates? | | |
| 11 | All single station smoke detectors have been tested for proper operation and have been made to properly operate at least twice? | | |

B. Interface with HVAC System(s).

A representative of the Division 24 Professional shall witness all functions of the HVAC system(s) which are initiated by and interfaced with the Fire Alarm System(s). The Division 24 Professional shall provide a signed statement of proper system operation as outlined in the Contract Documents and a copy of this statement shall be attached to this report when submitted for approval.

| | | YES | NO |
|---|---|---|---|
| 1 | All duct mounted smoke detectors have been installed per the manufacturer's recommendations and per the Contract Drawings? | | |
| 2 | Upon smoke detection by the duct mounted smoke detectors in each duct system, the proper air handling unit equipment shut down to the satisfaction of the Division 24 Professional? | | |

C. Interface with Fire Protection System(s).

A representative of the Division 22 Professional shall witness all functions of the Fire Protection System(s) which are supervised by and interfaced with the Fire Alarm System(s). The Division 22 Professional shall provide a signed statement of proper system operation as outlined in the Contract Documents and a copy of this statement shall be attached to this report when submitted for approval.

| | | YES | NO |
|---|---|---|---|
| 1 | Fire Alarm System connections have been made to all Fire Protection System supervisory devices (PIV, tamper switches, flow switches, etc.) and the Fire Alarm System recognizes each device connection? | | |
| 2 | Operation of PIV or tamper switches causes a trouble signal at the Fire Alarm System and was properly annunciated at the control panel(s) and the remote annunciator(s)? | | |
| 3 | Operation of the flow switch(es) causes a general alarm of the Fire Alarm System and was properly annunciated at the control panel(s) and the remote annunciator(s)? | | |
| 4 | The proper time delay between each flow switch(es) activation and initiation of the Fire Alarm System general alarm was observed? | | |

D. Interface with Elevator Control System(s).

A representative of the Division 14 Professional shall witness all functions of the Elevator Control System(s) which are initiated by and interfaced with the Fire Alarm System(s). The Division 14 Professional shall provide a signed statement of proper system operation as outlined in the Contract Documents and a copy of this statement shall be attached to this report when submitted for approval.

| | | YES | NO |
|---|---|---|---|
| 1 | Smoke detectors are installed in each elevator lobby, in the elevator equipment room(s) and at the top of the elevator shaft(s)? | | |
| 2 | Heat detectors are installed in the elevator equipment room(s) and at the top of the elevator shaft(s)? | | |
| 3 | If the building has a fire protection system (sprinkler system), the Fire Alarm System initiates the shunt-trip of the circuit breakers serving the elevator equipment prior to water flow? | | |
| 4 | Upon detection of smoke in the elevator lobby on any floor of the facility the Fire Alarm System provides the proper signal to the Elevator controller(s). | | |

E. Interface with Security System(s).

| | | YES | NO |
|---|---|---|---|
| 1 | When a general alarm and/or trouble signal is initiated at the Fire Alarm System, the proper signal was initiated at the Security System Control Panel? | | |

## INITIATING AND SUPERVISORY DEVICE TEST LOG

(make copies as required)

| Device Address | Device Type | Device Location | Visual Check | Functional Check | Pass | Fail |
|---|---|---|---|---|---|---|
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |
| | | | ( ) | ( ) | ( ) | ( ) |

Comments:_____

_____

_____

The above test report for the Fire Alarm and Detection System(s) is true and accurate to the best of my knowledge and per my system(s) testing and inspection, and the Fire Alarm and

Detection System(s) appears to be properly operating per the Contract Documents for this project.

Signature: _____ Date: _____

Print Name: _____ Title: _____

**End of Fire Alarm System Test Report**

# Appendix A:

# Owner-Furnished Asbestos-Containing Materials Survey and Assessment

Pickering

*Service and Good Work...*
*Our Foundation, Our Future*
*Since 1946*

October 11, 2012

Mr. Stan Wagnon
Burris Wagnon Architects P.A.
500L East Woodrow Wilson Avenue
Jackson, MS 39216

**RE: Asbestos Survey and Assessment Services**
**Robert E. Lee Building**
**Jackson, Mississippi**

Dear Mr. Wagnon:

You requested our services with respect to the presence of Asbestos-Containing Materials (ACM) prior to the renovation activities scheduled for the above-referenced property. As such, we conducted a site inspection on October 2, 2012, that included the collection and analysis of building material that are suspected to contain asbestos and are representative of the current building conditions.

Following our site inspection and sample collection activity, one (1) ACM was identified. This conclusion is based on the Environmental Protection Agency's (EPA) definition of ACM as material composed of "...greater than 1% asbestos." The ACMs identified on this property are:

- Pipe wrap in basement (REL-17)

Prior to the demolition of these buildings and/or the disturbance of these ACMs, a contractor who is licensed to handle asbestos should complete this activity. It is further recommended that a certified asbestos designer provide a design specification for the asbestos removal, and air monitoring be conducted before, during, and after the project. An abatement project of this type also requires that a written notification be submitted to the Mississippi Department of Environmental Quality (MDEQ) at least ten (10) working-days prior to the beginning of the project.

Please find attached a detailed report of findings that includes ACM quantities, estimated removal costs, and sample location drawings. Should you have any questions concerning this report, please do not hesitate to contact me.

Sincerely,
PICKERING FIRM, INC.

Beau Hale
Natural Resources Scientist

Enclosure

Cc: File 23216.13

# ASBESTOS-CONTAINING MATERIALS
# SURVEY AND ASSESSMENT
# FOR
# ROBERT E. LEE BUILDING
# JACKSON, MISSISSIPPI

**PRESENTED TO:**

**BURRIS WAGNON ARCHITECTS P.A.**
**500L EAST WOODROW WILSON AVENUE**
**JACKSON, MISSISSIPPI 39216**

**PREPARED BY:**

**PICKERING FIRM, INC.**
**2001 AIRPORT ROAD, SUITE 201**
**FLOWOOD, MISSISSIPPI 39232**

Pickering

**OCTOBER 2012**
**PROJECT NO. 23216.13**

## TABLE OF CONTENTS


| SECTION | | PAGE |
|---|---|---|
| 1.0 | EXECUTIVE SUMMARY | 1 |
| 2.0 | FINDINGS | 1 |
| 3.0 | RECOMMENDATIONS | 3 |
| 4.0 | COST ESTIMATE | 3 |
| 5.0 | APPENDICES | 4 |
| | 5.1 Laboratory Analysis Reports | |
| | 5.2 Drawings | |
| | 5.3 Certifications | |

## 1.0 EXECUTIVE SUMMARY

This Asbestos-Containing Material (ACM) inspection was performed to identify and assess the condition of suspect building materials and to provide recommended response actions based on the conditions **of** these materials. This report describes the survey tasks and presents our findings and recommendations.

The Robert E. Lee building is located on 239 North Lamar St. in Jackson, MS. The building is a thirteen-story structure consisting of a concrete slab foundation with a structural steel framework. Exterior consist of concrete masonry unit's walls and brick veneer. Interior floor finishes consists of terrazzo, bare concrete, and VCT flooring. The walls consisted of plaster, gypsum board and brick/concrete.

Prior to the initial walk-through inspection of the facility, special precautions and security/access requirements were coordinated with maintenance personnel. At the time of the inspection, all areas of the facilities were accessible.

During our inspection, all areas of the building were visually inspected and the locations of suspected ACM's were noted. After all suspect ACMs were identified, a minimum of two (2) samples were collected of each homogeneous material for sample analysis. These suspect asbestos samples were subsequently labeled and submitted to an accredited laboratory for asbestos analysis by Polarized Light Microscopy (PLM).

## 2.0 FINDINGS

During the asbestos survey, a total of forty-six (46) bulk material samples were collected and analyzed for asbestos content. According to the analytical results, one (1) asbestos-containing material was identified. This conclusion is based on the Environmental Protection Agency (EPA) definition of an ACM as material composed of "...greater than 1% asbestos."

The ACMs identified on this property are:

- **Pipe wrap on larger diameter piping in basement (REL-17).** Laboratory analysis revealed that it contains approximately 3% chrysotile asbestos. This material is classified as a friable ACM according to National Emission Standard for Hazardous Air Pollutants (NESHAP) regulations.

Sample analyses indicate that no asbestos was detected in the following materials:

- 2x2-foot wormhole ceiling tile (REL-01)
- 2x2-foot solid ceiling tile (REL-02)
- Black cove base & mastic (REL-03)
- Interior window caulking (REL-04)
- Black mastic on concrete (REL-05)
- 12x12-inch white floor tile & mastic (REL-06)
- Textured wall material (REL-07)
- Spray on insulation (REL-08)
- Gypsum board & mud (REL-09)
- 12x12-inch pink & beige floor tile & mastic (REL-10)
- Pipe mud (REL-11)
- Tan cove base & mastic (REL-12)
- Textured wall plaster (REL-13)
- 12x12-inch gray cove base & mastic (REL-14)
- Wall plaster (REL-15)
- Red cove base & mastic (REL-16)
- Cooling tower caulk (REL-18)

## 3.0 RECOMMENDATIONS-ASBESTOS

Considering these findings, NESHAP Regulations 40 CFR 61, Subpart M, requires the removal of ACM before any renovation or demolition takes place that will disturb those materials and render them friable. Therefore, any future expansion, demolition, or renovation activities at the facility that would impact any of these ACMs should follow the NESHAP regulations. Also, it is recommended that the removal work be designed by a certified asbestos project designer, and that air monitoring be conducted before, during, and after the abatement activity. A renovation project of this type will also require a written notification to be submitted to the Mississippi Department of Environmental Quality (MDEQ) ten (10) days prior to the beginning of the project.

## 4.0 COST ESTIMATE

The cost estimate table below represents a cost breakdown for the removal of each ACM material identified during the inspection. In developing this cost estimate, we have assumed this material will be included in a single abatement project. The cost estimate does not include abatement design costs or contractor oversight costs. These numbers are only a rough estimate. An asbestos abatement contractor's quote could be significantly higher or lower than the numbers presented here.

**Cost Breakdown for Removal of ACM**

| | | | Removal | |
|---|---|---|---|---|
| **Location** | **Material** | **Quantity** | **Unit Cost** | **Total Cost** |
| Basement | Pipe wrap | 300 LF | $15.00/LF | $4,500.00 |
| | Contractor Mobilization | | | 1,000.00 |
| | | **Abatement Total** | | **$5,500.00** |

**** - The square footage presented here is only a rough estimate; contractors should obtain their own measurements prior to submitting a cost estimate or bid.***

# 5.0 APPENDICES

# APPENDIX 5.1
# LABORATORY ANALYSIS REPORTS

**EMSL Analytical, Inc.**
11931 Industriplex, Suite 100, Baton Rouge, LA 70809
Phone/Fax: (225) 755-1920 / (225) 755-1989
http://www.emsl.com batonrougelab@emsl.com

| | |
|---|---|
| EMSL Order: | 251205812 |
| CustomerID: | POWE54 |
| CustomerPO: | 15177 |
| ProjectID: | |

Attn: **Zack Hultz**
**Pickering, Inc.**
**2001 Airport Road**
**Suite 201**
**Flowood, MS 39232**

Project: **23216.13 ROBERT E. LEE BUILDING**

| | |
|---|---|
| Phone: | (601) 956-3663 |
| Fax: | (601) 956-7817 |
| Received: | 10/04/12 10:00 AM |
| Analysis Date: | 10/5/2012 |
| Collected: | 10/2/2012 |

## Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

| | | | Non-Asbestos | | | | Asbestos |
|---|---|---|---|---|---|---|---|
| **Sample** | **Description** | **Appearance** | **%** | **Fibrous** | **%** | **Non-Fibrous** | **% Type** |
| REL-01-01 | | Gray | 60% | Cellulose | 13% | Non-fibrous (other) | **None Detected** |
| *251205812-0001* | | Fibrous Homogeneous | | | 25% | Perlite | |
| | | | | | 2% | Quartz | |
| REL-01-02 | | Gray | 45% | Cellulose | 10% | Non-fibrous (other) | **None Detected** |
| *251205812-0002* | | Fibrous Homogeneous | 15% | Min. Wool | 10% | Perlite | |
| | | | | | 20% | Ca Carbonate | |
| REL-02-01 | | Gray | 45% | Cellulose | 10% | Non-fibrous (other) | **None Detected** |
| *251205812-0003* | | Fibrous Homogeneous | 25% | Min. Wool | 20% | Ca Carbonate | |
| REL-02-02 | | Gray | 35% | Min. Wool | 10% | Non-fibrous (other) | **None Detected** |
| *251205812-0004* | | Fibrous Homogeneous | 50% | Cellulose | 5% | Ca Carbonate | |
| REL-03-01 | | Black | <1% | Glass | 100% | Non-fibrous (other) | **None Detected** |
| *251205812-0005* | | Non-Fibrous Homogeneous | | | | | |
| REL-03-02 | | Black | <1% | Glass | 95% | Non-fibrous (other) | **None Detected** |
| *251205812-0006* | | Non-Fibrous Homogeneous | | | <1% | Quartz | |
| | | | | | 5% | Ca Carbonate | |
| REL-04-01 | | Tan | 3% | Fibrous (other) | 8% | Non-fibrous (other) | **None Detected** |
| *251205812-0007* | | Non-Fibrous Homogeneous | | | 85% | Ca Carbonate | |
| | | | | | 4% | Quartz | |

Analyst(s)

*Shaun Dermond (35)*
*Susan Pollack (9)*

Michael Katsorchis, Laboratory Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Samples received in good condition unless otherwise noted. Estimated accuracy, precision and uncertainty data available upon request. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Reporting limit is 1%

Samples analyzed by EMSL Analytical, Inc. Piscataway, NJ NYS ELAP 11423, NVLAP Lab Code 101048-2, NJ NELAC 12037, PA DEP 68-03406

Initial report from 10/05/2012 15:24:48

**EMSL Analytical, Inc.**
11931 Industriplex, Suite 100, Baton Rouge, LA 70809
Phone/Fax: (225) 755-1920 / (225) 755-1989
http://www.emsl.com batonrougelab@emsl.com

| | |
|---|---|
| EMSL Order: | 251205812 |
| CustomerID: | POWE54 |
| CustomerPO: | 15177 |
| ProjectID: | |

Attn: **Zack Hultz**
**Pickering, Inc.**
**2001 Airport Road**
**Suite 201**
**Flowood, MS 39232**

Project: **23216.13 ROBERT E. LEE BUILDING**

| | |
|---|---|
| Phone: | (601) 956-3663 |
| Fax: | (601) 956-7817 |
| Received: | 10/04/12 10:00 AM |
| Analysis Date: | 10/5/2012 |
| Collected: | 10/2/2012 |

## Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

| | | | Non-Asbestos | | | Asbestos |
|---|---|---|---|---|---|---|
| **Sample** | **Description** | **Appearance** | **% Fibrous** | | **% Non-Fibrous** | **% Type** |
| REL-04-02<br>*251205812-0008* | | Tan<br>Non-Fibrous<br>Homogeneous | <1% Fibrous (other) | | 12% Non-fibrous (other)<br>85% Ca Carbonate<br>3% Quartz | **None Detected** |
| REL-05-01<br>*251205812-0009* | | Black<br>Non-Fibrous<br>Homogeneous | 2% Synthetic<br>15% Cellulose | | 38% Non-fibrous (other)<br>25% Ca Carbonate<br>20% Quartz | **None Detected** |
| REL-05-02<br>*251205812-0010* | | Black<br>Non-Fibrous<br>Homogeneous | 3% Cellulose | | 32% Non-fibrous (other)<br>55% Gypsum<br>10% Quartz | **None Detected** |
| REL-06-01<br>*251205812-0011* | | Beige<br>Non-Fibrous<br>Homogeneous | | | 12% Non-fibrous (other)<br>85% Ca Carbonate<br>3% Quartz | **None Detected** |
| REL-06-02<br>*251205812-0012* | | Beige<br>Non-Fibrous<br>Homogeneous | | | 12% Non-fibrous (other)<br>85% Ca Carbonate<br>3% Quartz | **None Detected** |
| REL-07-01<br>*251205812-0013* | | Tan<br>Non-Fibrous<br>Homogeneous | <1% Cellulose | | 11% Non-fibrous (other)<br>85% Ca Carbonate<br>4% Quartz | **None Detected** |

Analyst(s)

*Shaun Dermond (35)*
*Susan Pollack (9)*

Michael Katsorchis, Laboratory Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Samples received in good condition unless otherwise noted. Estimated accuracy, precision and uncertainty data available upon request. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Reporting limit is 1%

Samples analyzed by EMSL Analytical, Inc. Piscataway, NJ NYS ELAP 11423, NVLAP Lab Code 101048-2, NJ NELAC 12037, PA DEP 68-03406

Initial report from 10/05/2012 15:24:48

**EMSL Analytical, Inc.**
11931 Industriplex, Suite 100, Baton Rouge, LA 70809
Phone/Fax: (225) 755-1920 / (225) 755-1989
http://www.emsl.com batonrougelab@emsl.com

| | |
|---|---|
| EMSL Order: | 251205812 |
| CustomerID: | POWE54 |
| CustomerPO: | 15177 |
| ProjectID: | |

Attn: **Zack Hultz**
**Pickering, Inc.**
**2001 Airport Road**
**Suite 201**
**Flowood, MS 39232**

Project: **23216.13 ROBERT E. LEE BUILDING**

| | |
|---|---|
| Phone: | (601) 956-3663 |
| Fax: | (601) 956-7817 |
| Received: | 10/04/12 10:00 AM |
| Analysis Date: | 10/5/2012 |
| Collected: | 10/2/2012 |

## Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

| | | | Non-Asbestos | | | Asbestos |
|---|---|---|---|---|---|---|
| **Sample** | **Description** | **Appearance** | **% Fibrous** | | **% Non-Fibrous** | **% Type** |
| REL-07-02<br>*251205812-0014* | | Tan<br>Non-Fibrous<br>Homogeneous | <1% | Cellulose | 10% Non-fibrous (other)<br>85% Ca Carbonate<br>5% Quartz | **None Detected** |
| REL-08-01<br>*251205812-0015* | | Tan<br>Fibrous<br>Homogeneous | 20% | Cellulose | 30% Non-fibrous (other)<br>45% Mica<br>5% Quartz | **None Detected** |
| REL-08-02<br>*251205812-0016* | | Tan<br>Fibrous<br>Homogeneous | 25% | Cellulose | 21% Non-fibrous (other)<br>50% Mica<br>4% Quartz | **None Detected** |
| REL-09-01<br>*251205812-0017* | | Gray<br>Fibrous<br>Heterogeneous | 3% | Cellulose | 7% Non-fibrous (other)<br>60% Ca Carbonate<br>30% Gypsum | **None Detected** |
| REL-09-02<br>*251205812-0018* | | Gray<br>Fibrous<br>Heterogeneous | 2% | Cellulose | 18% Non-fibrous (other)<br>75% Gypsum<br>5% Quartz | **None Detected** |
| REL-09-03<br>*251205812-0019* | | Gray<br>Fibrous<br>Heterogeneous | 2% | Cellulose | 11% Non-fibrous (other)<br>65% Gypsum<br>20% Ca Carbonate<br>2% Quartz | **None Detected** |

Analyst(s)

*Shaun Dermond (35)*
*Susan Pollack (9)*

Michael Katsorchis, Laboratory Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Samples received in good condition unless otherwise noted. Estimated accuracy, precision and uncertainty data available upon request. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Reporting limit is 1%

Samples analyzed by EMSL Analytical, Inc. Piscataway, NJ NYS ELAP 11423, NVLAP Lab Code 101048-2, NJ NELAC 12037, PA DEP 68-03406

Initial report from 10/05/2012 15:24:48

**EMSL Analytical, Inc.**
11931 Industriplex, Suite 100, Baton Rouge, LA 70809
Phone/Fax: (225) 755-1920 / (225) 755-1989
http://www.emsl.com batonrougelab@emsl.com

| | |
|---|---|
| EMSL Order: | 251205812 |
| CustomerID: | POWE54 |
| CustomerPO: | 15177 |
| ProjectID: | |

Attn: **Zack Hultz**
**Pickering, Inc.**
**2001 Airport Road**
**Suite 201**
**Flowood, MS 39232**

| | |
|---|---|
| Phone: | (601) 956-3663 |
| Fax: | (601) 956-7817 |
| Received: | 10/04/12 10:00 AM |
| Analysis Date: | 10/5/2012 |
| Collected: | 10/2/2012 |

Project: **23216.13 ROBERT E. LEE BUILDING**

## Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

| | | | Non-Asbestos | | | Asbestos |
|---|---|---|---|---|---|---|
| **Sample** | **Description** | **Appearance** | **%** | **Fibrous** | **% Non-Fibrous** | **% Type** |
| REL-09-04<br>*251205812-0020* | | Gray<br>Fibrous<br>Heterogeneous | <1% | Cellulose | 7% Non-fibrous (other)<br>75% Gypsum<br>15% Ca Carbonate<br>3% Quartz | **None Detected** |
| REL-10-01-Floor Tile<br>*251205812-0021* | | Beige<br>Non-Fibrous<br>Homogeneous | | | 12% Non-fibrous (other)<br>85% Ca Carbonate<br>3% Quartz | **None Detected** |
| REL-10-01-Mastic<br>*251205812-0021A* | | | | | | **Insufficient Material** |
| REL-10-02-Floor Tile<br>*251205812-0022* | | Beige<br>Non-Fibrous<br>Homogeneous | | | 12% Non-fibrous (other)<br>85% Ca Carbonate<br>3% Quartz | **None Detected** |
| REL-10-02-Mastic<br>*251205812-0022A* | | Black<br>Non-Fibrous<br>Homogeneous | 6% | Synthetic | 79% Non-fibrous (other)<br>15% Ca Carbonate | **None Detected** |
| REL-10-03-Floor Tile<br>*251205812-0023* | | Beige<br>Non-Fibrous<br>Homogeneous | | | 13% Non-fibrous (other)<br>85% Ca Carbonate<br>2% Quartz | **None Detected** |
| REL-10-03-Mastic<br>*251205812-0023A* | | Black<br>Non-Fibrous<br>Homogeneous | 5% | Synthetic | 85% Non-fibrous (other)<br>10% Ca Carbonate | **None Detected** |

Analyst(s)

*Shaun Dermond (35)*
*Susan Pollack (9)*

Michael Katsorchis, Laboratory Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Samples received in good condition unless otherwise noted. Estimated accuracy, precision and uncertainty data available upon request. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Reporting limit is 1%

Samples analyzed by EMSL Analytical, Inc. Piscataway, NJ NYS ELAP 11423, NVLAP Lab Code 101048-2, NJ NELAC 12037, PA DEP 68-03406

Initial report from 10/05/2012 15:24:48

**EMSL Analytical, Inc.**
**11931 Industriplex, Suite 100, Baton Rouge, LA 70809**
Phone/Fax: (225) 755-1920 / (225) 755-1989
http://www.emsl.com batonrougelab@emsl.com

| | |
|---|---|
| EMSL Order: | 251205812 |
| CustomerID: | POWE54 |
| CustomerPO: | 15177 |
| ProjectID: | |

Attn: **Zack Hultz**
**Pickering, Inc.**
**2001 Airport Road**
**Suite 201**
**Flowood, MS 39232**

Project: **23216.13 ROBERT E. LEE BUILDING**

| | |
|---|---|
| Phone: | (601) 956-3663 |
| Fax: | (601) 956-7817 |
| Received: | 10/04/12 10:00 AM |
| Analysis Date: | 10/5/2012 |
| Collected: | 10/2/2012 |

## Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

| | | | Non-Asbestos | | | Asbestos |
|---|---|---|---|---|---|---|
| **Sample** | **Description** | **Appearance** | **% Fibrous** | | **% Non-Fibrous** | **% Type** |
| REL-11-01<br>*251205812-0024* | | White<br>Non-Fibrous<br>Homogeneous | 8% | Cellulose | 12% Non-fibrous (other)<br>80% Ca Carbonate | **None Detected** |
| REL-11-02<br>*251205812-0025* | | White<br>Non-Fibrous<br>Homogeneous | | | 15% Non-fibrous (other)<br>75% Ca Carbonate<br>10% Quartz | **None Detected** |
| REL-12-01-Cove Base<br>*251205812-0026* | | Tan<br>Non-Fibrous<br>Homogeneous | | | 30% Non-fibrous (other)<br>65% Ca Carbonate<br>5% Quartz | **None Detected** |
| REL-12-01-Mastic<br>*251205812-0026A* | | Brown<br>Non-Fibrous<br>Homogeneous | <1% | Cellulose | 88% Non-fibrous (other)<br>12% Ca Carbonate | **None Detected** |
| REL-12-02-Cove Base<br>*251205812-0027* | | Tan<br>Non-Fibrous<br>Homogeneous | | | 25% Non-fibrous (other)<br>70% Ca Carbonate<br>5% Quartz | **None Detected** |
| REL-12-02-Mastic<br>*251205812-0027A* | | Brown<br>Non-Fibrous<br>Homogeneous | <1% | Cellulose | 90% Non-fibrous (other)<br>10% Ca Carbonate | **None Detected** |
| REL-13-01<br>*251205812-0028* | | Gray<br>Non-Fibrous<br>Homogeneous | <1% | Cellulose | 13% Non-fibrous (other)<br>75% Gypsum<br>12% Quartz | **None Detected** |

Analyst(s)

*Shaun Dermond (35)*
*Susan Pollack (9)*

Michael Katsorchis, Laboratory Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Samples received in good condition unless otherwise noted. Estimated accuracy, precision and uncertainty data available upon request. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Reporting limit is 1%

Samples analyzed by EMSL Analytical, Inc. Piscataway, NJ NYS ELAP 11423, NVLAP Lab Code 101048-2, NJ NELAC 12037, PA DEP 68-03406

Initial report from 10/05/2012 15:24:48

**EMSL Analytical, Inc.**
**11931 Industriplex, Suite 100, Baton Rouge, LA 70809**
Phone/Fax: (225) 755-1920 / (225) 755-1989
http://www.emsl.com batonrougelab@emsl.com

| | |
|---|---|
| EMSL Order: | 251205812 |
| CustomerID: | POWE54 |
| CustomerPO: | 15177 |
| ProjectID: | |

Attn: **Zack Hultz**
**Pickering, Inc.**
**2001 Airport Road**
**Suite 201**
**Flowood, MS 39232**

Project: **23216.13 ROBERT E. LEE BUILDING**

| | |
|---|---|
| Phone: | (601) 956-3663 |
| Fax: | (601) 956-7817 |
| Received: | 10/04/12 10:00 AM |
| Analysis Date: | 10/5/2012 |
| Collected: | 10/2/2012 |

## Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

| | | | Non-Asbestos | | | Asbestos |
|---|---|---|---|---|---|---|
| **Sample** | **Description** | **Appearance** | **%** | **Fibrous** | **% Non-Fibrous** | **% Type** |
| REL-13-02<br>*251205812-0029* | | Gray<br>Non-Fibrous<br>Homogeneous | | | 30% Non-fibrous (other)<br>70% Quartz | **None Detected** |
| REL-14-01<br>*251205812-0030* | | Gray<br>Non-Fibrous<br>Homogeneous | | | 12% Non-fibrous (other)<br>88% Ca Carbonate | **None Detected** |
| REL-14-02<br>*251205812-0031* | | Gray<br>Non-Fibrous<br>Homogeneous | <1% | Cellulose | 13% Non-fibrous (other)<br>85% Ca Carbonate<br>2% Quartz | **None Detected** |
| REL-15-01<br>*251205812-0032* | | Gray<br>Fibrous<br>Homogeneous | <1% | Cellulose | 10% Non-fibrous (other)<br>45% Gypsum<br>45% Quartz | **None Detected** |
| REL-15-02<br>*251205812-0033* | | Gray<br>Fibrous<br>Homogeneous | <1% | Cellulose | 10% Non-fibrous (other)<br>50% Gypsum<br>40% Quartz | **None Detected** |
| REL-16-01-Cove Base<br>*251205812-0034* | | Red<br>Non-Fibrous<br>Homogeneous | <1% | Cellulose | 53% Non-fibrous (other)<br>45% Ca Carbonate<br>2% Quartz | **None Detected** |
| REL-16-01-Mastic<br>*251205812-0034A* | | Tan<br>Non-Fibrous<br>Homogeneous | <1% | Cellulose | 100% Non-fibrous (other) | **None Detected** |

Analyst(s)
*Shaun Dermond (35)*
*Susan Pollack (9)*

Michael Katsorchis, Laboratory Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Samples received in good condition unless otherwise noted. Estimated accuracy, precision and uncertainty data available upon request. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Reporting limit is 1%

Samples analyzed by EMSL Analytical, Inc. Piscataway, NJ NYS ELAP 11423, NVLAP Lab Code 101048-2, NJ NELAC 12037, PA DEP 68-03406

Initial report from 10/05/2012 15:24:48

**EMSL Analytical, Inc.**
11931 Industriplex, Suite 100, Baton Rouge, LA 70809
Phone/Fax: (225) 755-1920 / (225) 755-1989
http://www.emsl.com batonrougelab@emsl.com

| | |
|---|---|
| EMSL Order: | 251205812 |
| CustomerID: | POWE54 |
| CustomerPO: | 15177 |
| ProjectID: | |

Attn: **Zack Hultz**
**Pickering, Inc.**
**2001 Airport Road**
**Suite 201**
**Flowood, MS 39232**

Project: **23216.13 ROBERT E. LEE BUILDING**

| | |
|---|---|
| Phone: | (601) 956-3663 |
| Fax: | (601) 956-7817 |
| Received: | 10/04/12 10:00 AM |
| Analysis Date: | 10/5/2012 |
| Collected: | 10/2/2012 |

## Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

| | | | Non-Asbestos | | | Asbestos | |
|---|---|---|---|---|---|---|---|
| **Sample** | **Description** | **Appearance** | **%** | **Fibrous** | **% Non-Fibrous** | **%** | **Type** |
| REL-16-02-Cove Base<br>*251205812-0035* | | Red<br>Non-Fibrous<br>Homogeneous | | | 43% Non-fibrous (other)<br>55% Ca Carbonate<br>2% Quartz | | **None Detected** |
| REL-16-02-Mastic<br>*251205812-0035A* | | Tan<br>Non-Fibrous<br>Homogeneous | <1% | Cellulose | 95% Non-fibrous (other)<br>5% Ca Carbonate | | **None Detected** |
| REL-17-01<br>*251205812-0036* | | Blue<br>Fibrous<br>Homogeneous | 12% | Glass | 82% Non-fibrous (other)<br>3% Quartz | **3%** | **Chrysotile** |
| REL-17-02<br>*251205812-0037* | | | | | | | **Stop Positive (Not Analyzed)** |
| REL-18-01<br>*251205812-0038* | | Black<br>Non-Fibrous<br>Homogeneous | 25%<br>3% | Fibrous (other)<br>Cellulose | 72% Non-fibrous (other) | | **None Detected** |
| REL-18-02<br>*251205812-0039* | | Black<br>Non-Fibrous<br>Homogeneous | 25%<br>2% | Fibrous (other)<br>Cellulose | 73% Non-fibrous (other) | | **None Detected** |

Analyst(s)

*Shaun Dermond (35)*
*Susan Pollack (9)*

Michael Katsorchis, Laboratory Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Samples received in good condition unless otherwise noted. Estimated accuracy, precision and uncertainty data available upon request. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Reporting limit is 1%

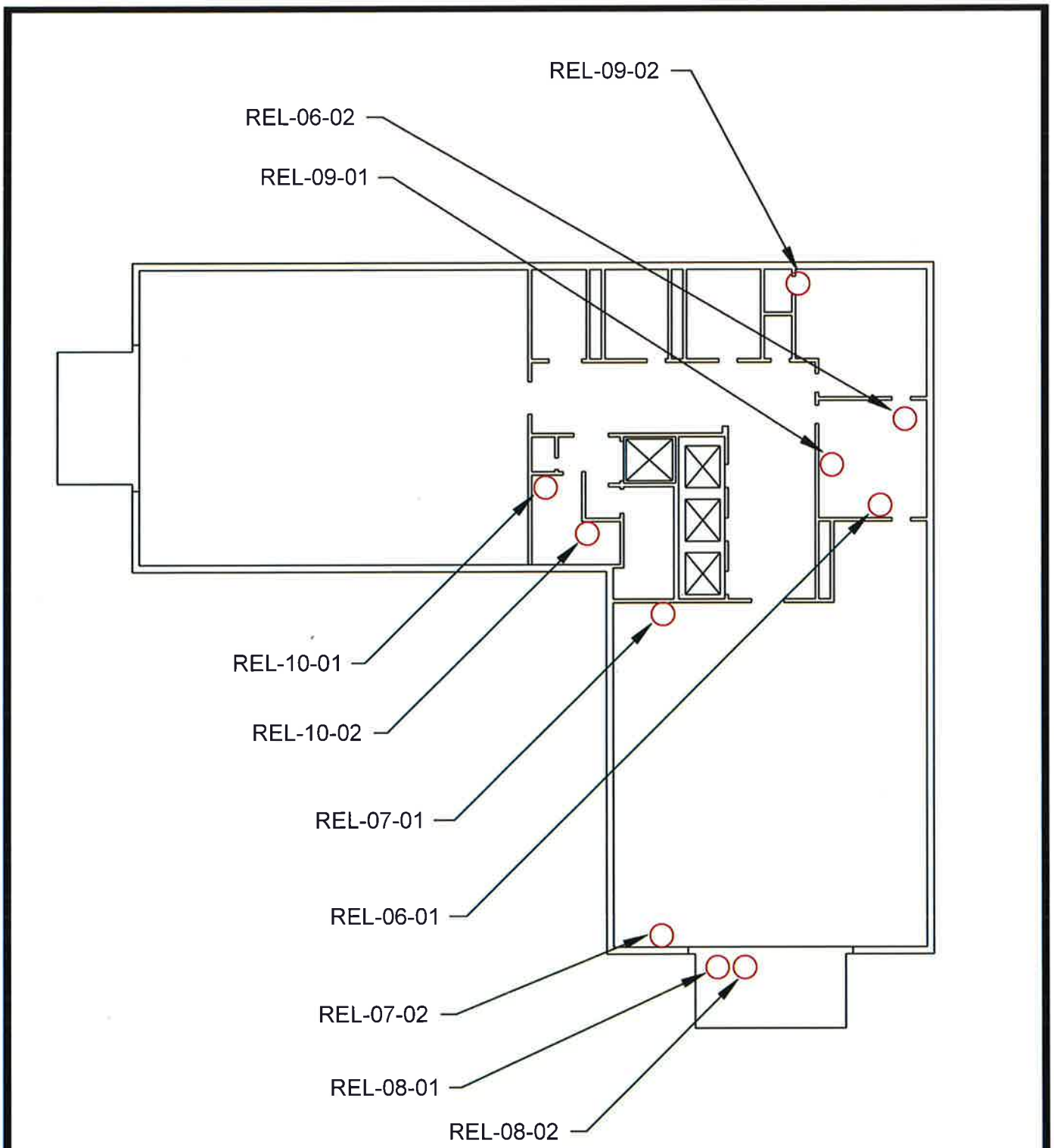
Samples analyzed by EMSL Analytical, Inc. Piscataway, NJ NYS ELAP 11423, NVLAP Lab Code 101048-2, NJ NELAC 12037, PA DEP 68-03406

Initial report from 10/05/2012 15:24:48



**THIS IS THE LAST PAGE OF THE REPORT.**

**APPENDIX 5.2**
**DRAWINGS**



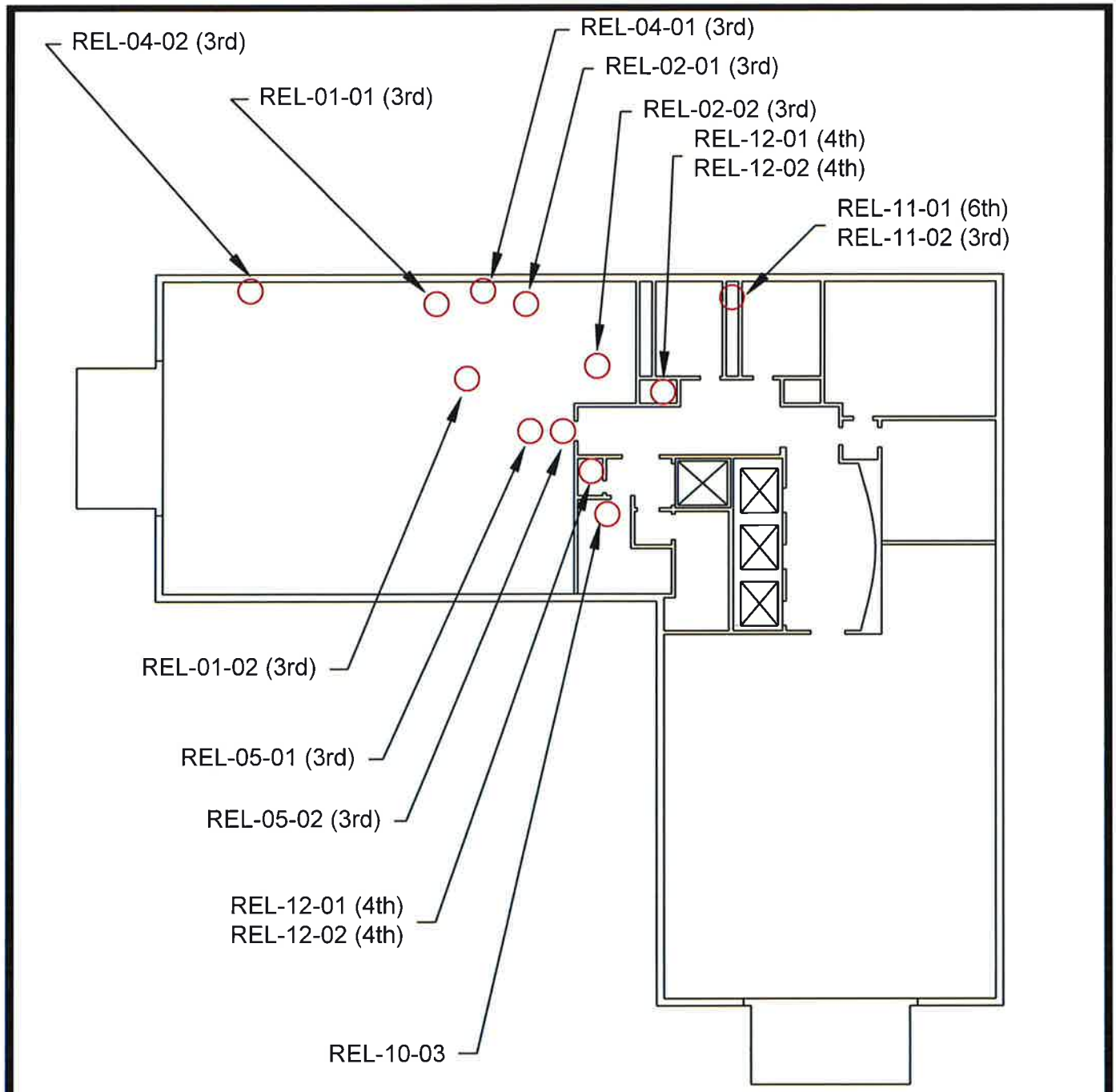

12th FLOOR

LEGEND

○ –Bulk Sample Location

● –Asbestos Containing Material Bulk Sample Location

| FIGURE #: | | | | |
|---|---|---|---|---|
| 1 | ASBESTOS SAMPLE LOCATIONS | ROBERT E. LEE BUILDING<br>JACKSON, MS | Pickering | PROJECT #: 23216.13<br>DATE: OCT 2012<br>DRAWN BY: BH<br>DESIGNER: WN<br>CHECKED BY: WN |



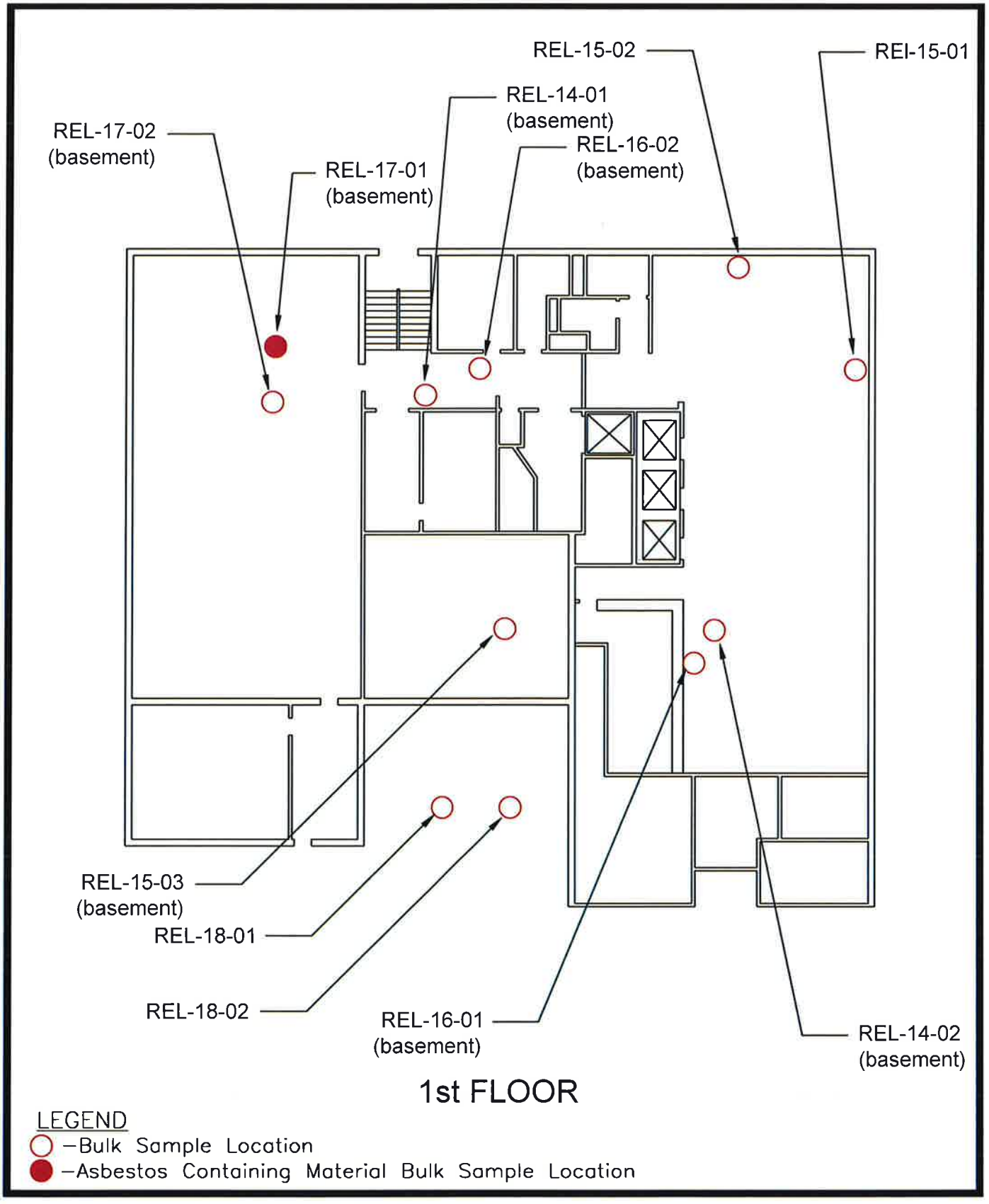

## 3rd - 10th FLOORS

LEGEND

○ – Bulk Sample Location

● – Asbestos Containing Material Bulk Sample Location

| FIGURE #: | | | | |
|---|---|---|---|---|
| 2 | ASBESTOS SAMPLE LOCATIONS | ROBERT E. LEE BUILDING<br>JACKSON, MS | Pickering | PROJECT #: 23216.13<br>DATE: OCT 2012<br>DRAWN BY: BH<br>DESIGNER: WN<br>CHECKED BY: WN |




1st FLOOR

LEGEND

○ –Bulk Sample Location

● –Asbestos Containing Material Bulk Sample Location

| FIGURE #: | | | | |
|---|---|---|---|---|
| 3 | ASBESTOS SAMPLE LOCATIONS | ROBERT E. LEE BUILDING<br>JACKSON, MS | Pickering | PROJECT #: 23216.13<br>DATE: OCT 2012<br>DRAWN BY: BH<br>DESIGNER: WN<br>CHECKED BY: WN |

**APPENDIX 5.3**
**CERTIFICATIONS**

# State of Mississippi

***Department of Environmental Quality***
***Office of Pollution Control***

## *Certificate of Licensure*

In accordance with the Asbestos Abatement Accreditation and Certification Act,
Enacted as 1989 Mississippi Law, Chapter 505

Be it known that

***Beau D. Hale***

Having submitted acceptable evidence of qualifications and
training and other appropriate information, is hereby granted this

## *Asbestos Inspector*

***Certification***

Jasmine S. Ashell

***Chief, Certification Branch***

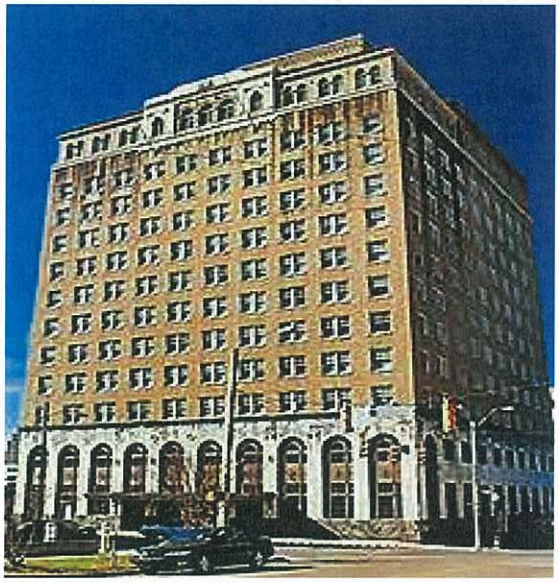
***Certificate No.: ABI-00001849***
***Expiration Date: Oct 19th, 2012***
***Training Expires on Oct 19th, 2012***

45619 LIC20110001

# Appendix B:

# Owner-Furnished Lead-Based Paint Inspection

# LEAD-BASED PAINT
# INSPECTION
# FOR
# ROBERT E LEE BUILDING
# JACKSON, MISSISSIPPI



**PRESENTED TO:**

**BURRIS WAGNON ARCHITECTS.**
**500 L EAST WOODROW WILSON**
**JACKSON, MISSISSIPPI 39216**

**PREPARED BY:**

**PICKERING FIRM, INC.**
**2001 AIRPORT ROAD, SUITE 201**
**FLOWOOD, MISSISSIPPI 39232**

Pickering

**OCTOBER 2012**
**PROJECT NO. 23216.13**

Pickering

*Service and Good Work...*
*Our Foundation, Our Future*
*Since 1946*

October 17, 2012

Mr. Bill Burris
Burris/Wagnon Architects, P.A.
500L East Woodrow Wilson Avenue
Jackson, MS 39216

via email: bill@burriswagnon.com

RE: Lead-Based Paint Inspection for Planned Interior Renovations
Robert E. Lee Building
Jackson, Mississippi
GS#354-058

Dear Mr. Burris:

You have requested our services with respect to the presence of Lead-Based Paints (LBP) at the above-referenced Property. As such, we conducted a site inspection that included the collection and analysis of painted building components that are representative of the current building conditions.

This inspection included identifying and sampling a number of representative interior and exterior paints with an XRF analyzer. A number of paints with a positive reading were then sampled by collecting paint chips and sending to a laboratory for analysis by flame atomic absorption. The following is a list of paints identified by the XRF analyzer.

- Gray paint on interior of wood window
- White paint on rough plaster walls in ballroom
- White paint on wood windows
- Gray paint on wood wall base and molding
- Gray paint on plaster walls by stairwells
- Lt. gray paint on rough plaster walls in lobby

Should future renovation plans include the intentional disturbance of the LBP containing material identified, it is recommend the contractor performing work be made aware of this LBP material prior any disturbance. All work should comply with all aspects of the OSHA Construction Standard for Lead (29 CFR 1926.62). No activities such as sanding, grinding or

sandblasting should be performed on any of the above paint. All disposal of LBP shall be in accordance with applicable solid and hazardous waste regulations.

Please find attached a report of findings that includes LBP material quantities, sample location descriptions and laboratory results1. Should you have any questions concerning this report, please do not hesitate to contact me.

Sincerely,
PICKERING FIRM, INC.

Willie J. Nester

Willie J. Nester
Lead inspector

Enclosure

cc: File 23216.13

## TABLE OF CONTENTS


| SECTION | | PAGE |
|---|---|---|
| 1.0 | EXECUTIVE SUMMARY | 1 |
| 2.0 | FINDINGS –LEAD BASED PAINT | 1 |
| 3.0 | RECOMMENDATIONS - LEAD BASED PAINT | 5 |
| APPENDIX A | LABORATORY ANALYSIS REPORTS | |
| APPENDIX B | INSPECTOR CERTIFICATIONS | |

## 1.0 EXECUTIVE SUMMARY

This Lead-Based Paint (LBP) survey was performed to identify and assess the condition of suspect building materials, and to provide recommended response actions based on the conditions of these materials. This report describes the survey tasks and presents our findings and recommendations.

Prior to the initial walk-through inspection of the facility, special precautions and security/access requirements were coordinated with the building's facility personnel. At the time of the inspection, all areas of the facility were accessible.

During our inspection, all exterior areas of the building were visually inspected, and the locations of suspected LBP's were noted. An XRF analyzer was used to identify LBP's. Any positive results were analyzed by taking paint chips and sending them to a laboratory to be analyzed by flame atomic absorption (FAA).

## 2.0 FINDINGS - LEAD-BASED PAINT

During the limited LBP survey a total of 99 XFR readings were taken in all twelve floors. Several positive readings were recorded from various painted surfaces. To eliminate the possibility that the substrate was causing the positive readings, two paint chip samples were collected of selected paints that were positive on the XRF analyzer and sent to a laboratory for analysis. Of the six paints sampled, one was determined by laboratory analysis to contain greater than 0.5% lead by weight, which is the level that defines lead based paint by Housing and Urban Development's (HUD) standards. This could be caused by the substrate being contaminated from previous coats of LBPs. However, we still recommend all paints that were identified by the XRF analyzer as LBPs be treated as LBPs in this project.

### X-Ray Fluorescent Analyzer Results

Below are the XRF readings for all paint tested with positive readings in bold:

| **XFR Reading** | **Description** | **Sample Location** | **Results ($mg/cm^2$)** |
|---|---|---|---|
| 01 | Calibration test | | |
| **02** | **Gray paint on windows sill** | **3rd floor** | **2.39** |
| 03 | Light gray paint on plaster wall | 3rd floor | 0.98 |
| **04** | **Gray paint on window frame** | **3rd floor** | **1.09** |
| 05 | Light gray paint on plaster wall | 3rd floor | 0.05 |
| 06 | Lt. gray paint on sheetrock wall | 3rd floor | 0.0 |
| 07 | void | | |

| XFR Reading # | Description | Sample Location | Results ($mg/cm^2$) |
|---|---|---|---|
| 08 | White paint on concrete ceiling | 3rd floor | 0.63 |
| 09 | Light gray paint on wood windows | 3rd floor | 0.01 |
| 10 | Re-calibration | | |
| **11** | **White paint on rough plaster wall** | **12th floor ballroom** | **1.84** |
| **12** | **White paint on rough plaster wall** | **12th floor ballroom** | **3.65** |
| 13 | Gray paint on metal windows | 12th floor ballroom | 0.0 |
| 14 | Gray paint on metal windows | 12th floor ballroom | 0.0 |
| 15 | Green door paint | 12th floor ballroom | 0.0 |
| 16 | Green paint on concrete beams | 12th floor | 0.24 |
| 17 | Yellow paint on concrete beams | 12th floor | 0.29 |
| 18 | Pink paint on sheetrock wall | 12th floor lobby | 0.0 |
| 19 | Pink paint on plaster wall | 12th floor lobby | 0.0 |
| 20 | Blue paint on elevator door | 12th floor lobby | 0.06 |
| 21 | White paint on plaster wall | 12th floor (room by stairwell) | 0.0 |
| 22 | White paint on plaster wall | 12th floor conf. room | 0.0 |
| 23 | Lt. Beige paint on wood wallboard | 12th floor conf. room | 0.0 |
| 24 | Silver paint on concrete ceiling | 12th floor Ballroom | 0.05 |
| 25 | White paint on plaster ceiling | 12th floor lobby | 0.0 |
| **26** | **White paint on wood window** | **11th floor** | **3.18** |
| 27 | Light gray paint on plaster walls | 11th floor | 0.72 |
| 28 | Gray paint on plaster walls | 11th floor | 0.00 |
| 29 | Gray paint on wood wallboard | 11th floor | 0.17 |
| 30 | White paint on sheetrock ceiling | 11th floor | 0.0 |
| 31 | White paint on sheetrock wall | 11th floor | 0.0 |
| 32 | **White paint on wood window** | **11th floor** | **1.34** |
| 33 | White paint on wood windows | 10th floor | 0.11 |
| 34 | Light gray paint on plaster wall | 10th floor | 0.02 |
| 35 | White paint on wood windows | 10th floor | 0.11 |
| **36** | **Gray paint on wood wallboard** | **10th floor** | **2.83** |
| 37 | White paint on wood windows | 10th floor | 0.15 |
| 38 | Light gray paint on plaster wall | 10th floor | 0.49 |
| 39 | Lt. gray paint on sheetrock ceiling | 10th floor | 0.0 |
| **40** | **Gray paint on wood wallboard** | **10th floor** | **1.64** |
| 41 | Gray paint on doors | 10th floor | 0.31 |
| 42 | **Gray paint on wall molding** | **10th floor** | **3.17** |
| 43 | Light gray paint on plaster wall | 8th floor | 0.0 |
| 44 | Gray paint on wood wallboard5 | 8th floor | 0.22 |

| XFR Reading # | Description | Sample Location | Results ($mg/cm^2$) |
|---|---|---|---|
| **45** | **White paint on wood windows** | **8th floor** | **3.32** |
| 46 | Calibration test | | |
| 47 | Lt. Gray paint on sheetrock wall | 9th floor | 0.0 |
| 48 | Gray paint on wood wallboard | 9th floor | 0.0 |
| **49** | **Gray paint on plaster walls** | **9th floor (by stairs)** | **1.86** |
| **50** | **White paint on wood windows** | **9th floor** | **2.87** |
| **51** | **Gray paint on wood wall molding** | **9th floor** | **1.85** |
| 52 | Gray paint on wood wallboard | 9th floor | 0.0 |
| 53 | Light gray paint on plaster wall | 9th floor | 0.0 |
| **54** | **White paint on wood windows** | **9th floor** | **1.0** |
| 55 | Light gray paint on plaster wall | 9th floor | 0.0 |
| 56 | White paint on plaster ceiling | 9th floor | 0.0 |
| 57 | Sample failed | | |
| 58 | Calibration | | |
| 59 | Light gray paint on plaster wall | 7th floor | 0.0 |
| 60 | Lt. gray paint on sheetrock wall | 7th floor | 0.0 |
| 61 | Black paint on wood wall base | 7th floor | 0.0 |
| 62 | Gray paint on wood wall base | 7th floor | 0.0 |
| 63 | Gray paint on wood wall molding | 7th floor | 0.0 |
| 64 | Gray paint on bathroom partition | 6th floor | 0.0 |
| 65 | Lt. gray paint on plaster wall | 6th floor mech. closet | 0.0 |
| **66** | **Gray paint on plaster wall** | **6th floor (by stairs)** | **1.00** |
| 67 | Gray paint on sheetrock | 6th floor | 0.0 |
| 68 | Gray paint on wood wall base | 6th floor | 0.04 |
| 69 | Lt. gray paint on plaster wall | 4th floor | 0.0 |
| 70 | Gray paint on wood wall base | 4th floor | 0.0 |
| 71 | Gray paint on wood wall molding | 4th floor | 0.0 |
| 72 | Gray paint on wood wall base | 5th floor | 0.0 |
| 73 | Gray paint on wood molding | 5th floor | 0.0 |
| 74 | White paint on plaster ceiling | 5th floor | 0.0 |
| 75 | Gray paint on wood wall molding | 3rd floor | 0.0 |
| 76 | Gray paint on wood wall base | 3rd floor | 0.0 |
| 77 | Sample voided | | |
| 78 | Recalibration | | |
| 79 | Lt. gray paint on sheetrock walls | 2nd floor | 0.0 |
| 80 | Sample voided | | |
| **81** | **Lt. gray paint on rough plaster walls** | **2nd floor** | **1.61** |
| 82 | Blue paint on wood wall base | 2nd floor | 0.04 |

| XFR Reading # | Description | Sample Location | Results ($mg/cm^2$) |
|---|---|---|---|
| 83 | Lt. gray paint on plaster wall | 2nd floor | 0.0 |
| 84 | Blue paint on wood wall molding | 2nd floor | 0.0 |
| 85 | Gold paint on plaster molding | Overlooking 1st floor lobby | 0.90 |
| 86 | Lt. gray paint on plaster wall | 1st floor | 0.0 |
| 87 | Lt. gray paint on rough plaster wall | 1st floor | 1.86 |
| 88 | Lt. gray paint on metal window | 1st floor | 0.0 |
| 89 | Gray paint on plaster wall | 1st floor | 0.0 |
| 90 | Lt. gray paint on cinder block wall | Basement | 0.12 |
| 91 | White paint on concrete ceiling | Basement | 0.11 |
| 92 | Blue paint on pipe insulation | Basement | 0.0 |
| 93 | Dark gray paint on wood door | Basement | 0.74 |
| 94 | White paint on ductwork | Basement | 0.0 |
| **95** | **Gray paint on wood window** | **Basement** | **3.40** |
| **96** | **Gray paint on plaster wall** | **Near penthouse** | **2.51** |
| 97 | Gray paint on stairs | Stairwell | 0.06 |
| 98 | Gray paint on cooling tower | Exterior mechanical area | 0.05 |
| 99 | Gray paint on cooling tower | Exterior mechanical area | 0.41 |

**Paint Chip Samples Collected and Analyzed by Flame Atomic Absorption**

The following paint chip samples were collected and sent to a accredited laboratory to be analyzed by flame atomic absorption methods (Note: these samples were for comparison purposes only and should not supercede the XRF results):

| Sample No. | Description | Sample Location | Results (% by wt.) |
|---|---|---|---|
| RELL-01-01 | Gray paint on wood windows | 3rd floor | 0.44 |
| **RELL-01-02** | **Gray paint on wood windows** | **Basement** | **0.59** |
| RELL-02-01 | White paint on rough plaster wall | Ballroom (12th) | 0.060 |
| RELL-02-02 | White paint on rough plaster wall | Ballroom (12th) | 0.10 |
| RELL-03-01 | White paint on wood windows | 11th floor | 0.25 |
| RELL-03-02 | White paint on wood windows | 8th floor | 0.23 |
| RELL-04-01 | Gray paint on wood wall base | 10th floor | <0.037 |
| RELL-04-02 | Gray paint on wood wall molding | 9th floor | <0.014 |
| RELL-05-01 | Gray paint on plaster wall | 9th floor (by stairs) | 0.13 |
| RELL-05-02 | Gray paint on plaster wall | 6th floor (by stairs) | 0.047 |
| RELL-06-01 | Lt. gray paint on rough plaster | 1st floor lobby | 0.048 |
| RELL-06-01 | Lt. gray paint on rough plaster | 1st floor lobby | <0.020 |

## 3.0 RECOMMENDATIONS – LEAD-BASED PAINT

Current lead regulations do not apply to renovation projects unless it is specifically performing a lead abatement. Contractor must however abide by OSHA regulation concerning their worker exposure to lead paint during a renovation project. No sanding, sawing, drilling, scraping or sand blasting of LBP surfaces should be performed. Dispose of all LBP as required by applicable solid and hazardous waste regulations.

# APPENDICES

# APPENDIX A
# LABORATORY ANALYSIS REPORTS

**LEAD-BASED PAINT**

**EMSL Analytical, Inc.**
**11931 Industriplex, Suite 100, Baton Rouge, LA 70809**
Phone/Fax: (225) 755-1920 / (225) 755-1989
http://www.emsl.com batonrougelab@emsl.com

| | |
|---|---|
| EMSL Order: | 251205813 |
| CustomerID: | POWE54 |
| CustomerPO: | 15177 |
| ProjectID: | |

Attn: **Zack Hultz**
**Pickering, Inc.**
**2001 Airport Road**
**Suite 201**
**Flowood, MS 39232**

| | |
|---|---|
| Phone: | (601) 956-3663 |
| Fax: | (601) 956-7817 |
| Received: | 10/04/12 10:00 AM |
| Collected: | 10/2/2012 |

Project: **23216.13 ROBERT E. LEE BLDG**

## Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B*/7000B)

| *Client Sample Description* | *Lab ID* | *Collected* | *Analyzed* | *Lead Concentration* |
|---|---|---|---|---|
| RELL-01-01 | *0001* | 10/2/2012 | 10/5/2012 | 0.44 % wt |
| RELL-01-02 | *0002* | 10/2/2012 | 10/5/2012 | 0.59 % wt |
| RELL-02-01 | *0003* | 10/2/2012 | 10/5/2012 | 0.060 % wt |
| RELL-02-02 | *0004* | 10/2/2012 | 10/5/2012 | 0.10 % wt |
| RELL-03-01 | *0005* | 10/2/2012 | 10/5/2012 | 0.25 % wt |
| RELL-03-02 | *0006* | 10/2/2012 | 10/5/2012 | 0.23 % wt |
| RELL-04-01 ** | *0007* | 10/2/2012 | 10/5/2012 | <0.037 % wt |
| RELL-04-02 ** | *0008* | 10/2/2012 | 10/5/2012 | <0.014 % wt |
| RELL-05-01 | *0009* | 10/2/2012 | 10/5/2012 | 0.13 % wt |
| RELL-05-02 | *0010* | 10/2/2012 | 10/5/2012 | 0.047 % wt |
| RELL-06-01 ** | *0011* | 10/2/2012 | 10/5/2012 | 0.048 % wt |
| RELL-06-02 ** | *0012* | 10/2/2012 | 10/5/2012 | <0.020 % wt |

** Data reported may not reach applicable analytical sensitivity due to insufficient sample weights submitted.
Suggested weight for analysis is 0.2g.

Michael Katsorchis

Michael Katsorchis, Laboratory Manager
or other approved signatory

Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. The QC data associated with these results included in this report meet the method QC requirements, unless specifically indicated otherwise. Unless noted, results in this report are not blank corrected. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. * slight modifications to methods applied. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request.

Samples analyzed by EMSL Analytical, Inc. Baton Rouge, LA LELAP 01950, A2LA Accredited Environmental Testing Cert #2845.03

Initial report from 10/05/2012 11:59:08

# APPENDIX B
# INSPECTOR CERTIFICATIONS

STATE OF MISSISSIPPI
PHIL BRYANT
GOVERNOR
MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY
TRUDY D. FISHER, EXECUTIVE DIRECTOR

March 12, 2012

Willie J. Nester
Pickering Firm, Inc.
2001 Airport Road
Flowood, Mississippi 39232

Re: Certificate of Licensure
Lead Risk Assessor Certification

Your application for certification as a Lead-Based Paint Lead Risk Assessor has been approved by the Lead Certification Branch in accordance with the Mississippi Regulations for Lead-Based Paint Activities, Miss. Code Annotated Sections 49-17-501 through 49-17-531. Your Mississippi Certification number is PRA-00001028. It is reflected on your enclosed Mississippi Certification identification card.

Your Mississippi Certification is valid through Mar 11th, 2013. In order to maintain certification as a Lead-Based Paint Lead Risk Assessor, you must renew your license on or before the expiration date stated on your card and pay the renewal fee. If you should continue to perform lead-based paint activities after the expiration date, you will be in violation of the Mississippi Regulations for Lead-Based Paint Activities and may be cited for non-compliance.

**It is your responsibility to ensure that you have met all the requirements for renewal of your lead certification.**

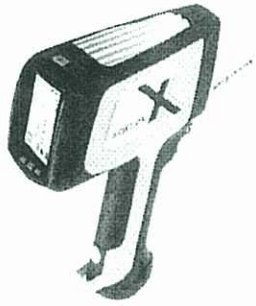
If you have any questions, please feel free to contact Virginia Rickels at (601) 961-5777.

Sincerely

Jimmie S. Asbill, P.E., Chief
Asbestos & Lead Certification Branch

Enclosure
cc:

48425 LIC20120001

# Certificate of  Completion

## This Certifies that

# Willie Nester

**has successfully completed the Olympus NDT Radiation Safety & Operator Training for field portable X-Ray Fluorescence Spectrum Analyzers**

*Bill Caughie*
Authorized Trainer
Olympus NDT

Completion Date
July 18, 2012

*Michael L. Tremblay*
Corporate RSO
Olympus NDT